# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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# RADIOLOGY

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Vol. 55 AUGUST 1950 No. 2

# The Role of the Internist in the Detection and Early Diagnosis of Gastric Carcinoma[1]

CHARLES L. BROWN, M.D.

Philadelphia, Penna.

In 1944 Bockus (1) stated that gastric carcinoma "is responsible for the death of about 30,000 persons in the United States annually. From 2 to 4 per cent of all adults die of gastric carcinoma, and it accounts for approximately 20 per cent of all cancer deaths in the United States."

The most important factor in the early diagnosis of gastric carcinoma is that the patient seek the opinion and advice of his physician. The factor next in importance is that the physician have the understanding and professional skill to recognize the possibility of a malignant growth and advise a proper and adequate diagnostic survey to determine whether such a lesion is present. The absence of symptoms for so long a time, the rather innocuous character of the presenting symptoms, and their lack of any particular pattern, lead first to delay on the part of the patient in seeking advice and then to delay on the part of the physician in instituting a diagnostic study. How can the patient be encouraged to come to the physician during the asymptomatic stage, this being the most critical time for altering the present rate of cure and survival beyond the five year postoperative period?

Periodic health examination, in order to be effective, demands plenty of time to obtain an exhaustive history, as well as special diagnostic procedures, which are often omitted because of cost and inconvenience, or for lack of any suggestive evidence in the history, or because some slight lead which it offers is unrecognized. Unfortunately there is an undesirable aspect to this matter of early diagnosis, namely, the development of a rich background for cancerphobia, if the physician is overzealous in his recommendations, and the unnecessary inconvenience and expense of special diagnostic measures. In no other field of practice is it more important to pay attention to every detail in history and diagnostic study, and act upon it with skill and precision. Inasmuch as x-ray examinations have been the most definite and effective means of diagnosing gastric carcinoma, some type of roentgen screening of the public, similar to photofluorography of the chest in the diagnosis of pulmonary disease, would seem to offer most in the early diagnosis in the asymptomatic group. Certain studies of this type, however, have not been encouraging. Dailey (2) found no cancer of the stomach in 500 men over the age of forty-five years. In the studies by St. John, Swenson, and Harvey (3), the

[1] From the Department of Medicine, Hahnemann Medical College and Hospital, Philadelphia, Penna. Presented before the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

incidence was 1.24 per thousand, which indicates the impracticability of the usual x-ray examination as a screening method.

*The History:* The early detection of carcinoma of the stomach, from the standpoint of the history, is a challenge in three groups of patients: (*a*) those without gastro-intestinal symptoms, who come to the physician for a general examination or because of some definite complaint; (*b*) those with gastro-intestinal symptoms; (*c*) those having some other known condition, with subsequent development of gastro-intestinal symptoms.

The symptoms of gastric carcinoma, when they occur, may be vague. If the lesion is located in the region of the pylorus or near the esophagogastric junction, interference with the passage of food in these regions may be the first evidence of disease. Otherwise, and even so, the carcinoma may have reached a large size before causing symptoms. Loss of appetite, a "feeling of fullness" in the epigastrium, and slight nausea are considered early symptoms. Often the patient may speak of some kind of epigastric discomfort. Slight dysphagia may occur early in carcinoma of the upper part of the cardia. More often than not the history of gastro-intestinal symptoms is of short duration. Probably not more than 10 per cent of patients with gastric carcinoma give a long history of dyspepsia, that is, over one or two years. Loss of weight, weakness, anemia, and cachexia are late symptoms. The "peptic ulcer syndrome" may have been present, the unhealed gastric ulcer becoming malignant, with an accompanying change in symptoms; or indeed, the symptoms of carcinoma in the region of the pylorus may simulate those ordinarily ascribed to ulcer, such as postprandial distress, a sense of epigastric fullness, relieved temporarily by antacids. Probably this similarity of symptoms is related to the disturbed motor physiology of the pyloric region.

It is obvious that there are no symptoms characteristic of early gastric carcinoma. The physician is familiar, however, with symptomatic patterns which suggest peptic ulcer, chronic gastritis, lower esophageal obstruction, pyloric obstruction, gastric retention, chronic cholecystitis and cholelithiasis, bowel irritability, bowel obstruction, and other well established digestive conditions. Carcinoma of the stomach in its advanced stages may mimic some of these conditions, Diarrhea, for example, may result from the achlorhydria, simulating colonic disease. When such symptoms occur, either in patterns or not, the physician must appraise the clinical features to determine the proper approach to further diagnostic survey. He must be alert to the possibility of gastric cancer, especially in the male of fifty or over who has had gastro-intestinal symptoms for the first time in his life only recently, that is, in the last one to three months. When other diseases or conditions are present, which may be manifest by gastro-intestinal symptoms, it is all the more difficult to evaluate the possibility of a malignant growth, and a complete gastro-intestinal diagnostic survey may be not only desirable but essential.

Bockus (1) has said very aptly that "the physician's most valuable asset in the diagnosis of gastric carcinoma is eternal vigilance—always keeping the possibility of cancer in mind to account for any disturbance of digestive function occurring for the first time after the patient has reached the age of thirty-five years." I would call attention especially to the words "occurring for the first time." Large numbers of persons, often over thirty-five years of age, have functional nervous disorders in which gastro-intestinal symptoms are frequent and predominant; one must take particular care to avoid cancerphobia in such patients, but no one can deny the advisability of thorough diagnostic study, at least a gastro-intestinal x-ray series, to serve as reassurance as well as to rule out organic disease more certainly.

*Gastric Analysis:* The next most available diagnostic aid in the detection of gastric carcinoma is the gastric analysis. Any physician, or his technician, can perform it, and it is inexpensive. The time has gone when any one of us would be willing

to depend predominantly on the gastric acid curve and other findings in the gastric analysis to establish the diagnosis, but it may yield much information about physiologic disturbance, and even pathologic change, that is helpful in interpreting other diagnostic findings and intelligently managing treatment. It should be done in every case; when it should be done in reference to other studies may be questionable, but this is relatively unimportant. It is usually preferable that it precede the x-ray examination, but frequently the latter is done first to expedite the study.

One might question the necessity of gastric analysis in the event that x-ray diagnosis is unquestionably positive. What then is to be gained by a study of the gastric contents? In spite of a seemingly certain diagnosis, it is desirable to know the nature and quantity of the fasting contents, the degree and pattern of gastric acidity, both free and combined, or the presence of achlorhydria, if intelligent preoperative care and preparation are to be given. Also, unexpected findings in the gastric analysis may serve as a caution in interpreting too positively certain x-ray findings.

The gastric analysis serves a most useful purpose in differentiating peptic ulcer from an ulcerating malignant lesion, though one must remember that only about three-fourths of the cases of gastric carcinoma are accompanied by marked hypochlorhydria or achlorhydria. A high combined acidity, or high ratio of combined acidity to total acidity, is expected in carcinoma. A lesion thought to be peptic ulcer, accompanied by achlorhydria, is probably malignant. The presence of lactic acid and Boas-Oppler bacilli does not certainly mean carcinoma but speaks for achlorhydria with gastric retention, which is commonly due to cancer.

*X-ray Examination of the Stomach:* Of all of the diagnostic aids in the detection of gastric cancer, the x-ray examination is the most important; in the hands of the roentgenologist it is of very high accuracy, 90 per cent or above in those cases that are detectable by any means. Although the gastroenterologist will probably have x-ray facilities or even conduct the examination himself, relatively few internists perform their own roentgen examinations. The role of the internist, therefore, is that of selection of patients for x-ray examination. This is not easy for several reasons. It is impracticable to submit everyone who has some gastric complaint to a time-consuming and expensive gastro-intestinal x-ray series. On the other hand, every patient suspected of having a gastric cancer should certainly have x-ray examination, and, for that matter, any patient having gastric complaints when the diagnosis remains obscure longer than a month, or when symptoms are not relieved by usual therapeutic measures. Indeed, the problem may be that of deciding which case *not* to send for x-ray examination.

*Gastroscopic Examination:* X-ray examination always should be made before gastroscopy, so that the gastroscopist may be aware of any abnormality or pathologic lesion which would influence the advisability of, or call for caution in, the performance of this procedure. Undoubtedly there are malignant lesions which may be detected by the gastroscope when they have not been found radiologically. In general, if the x-ray diagnosis is positive, gastroscopy is not necessary, but additional information thus afforded concerning the extent and local character of the lesion may be helpful to the surgeon in planning the resection. Gastroscopy is useful, and should be encouraged, but it must be recognized that there are many limitations to its application. Essentially it should be used in selected cases as supplementary to the x-ray examination. When and where gastroscopy is readily available, its more liberal use should be encouraged. Wirts (4) has illustrated the usefulness of the procedure, especially in the cancers of the cardia. Among 57 patients with gastric cancer, there were 23 in whom the lesion was found in the cardia. In 6 the lesion in the cardia was primary; in the other 17 it was secondary to disease elsewhere. Of the 6 primary lesions only one was recog-

nized by x-ray; the other 5 were diagnosed by gastroscopy alone. In 5 other cases the cardia was found by gastroscopy to be involved by secondary extension of a lesion lower in the body of the stomach, when this had not been demonstrated by x-ray.

*Exfoliative Cytology (the Papanicolaou Method):* To be reliable, cytologic studies of the gastric contents must be performed by one with considerable background in pathology and especially trained in this particular technic. Again, this method is useful mainly as a supplement to x-ray examination. In the interpretation of the findings, one must recognize the limitations of the method and must be aware of the possibility of false negatives and false positives, which may be misleading. It seems certain that the accuracy and usefulness of this aid improve with the skill and increased experience of the individual technician and physician using it.

Papanicolaou and Cooper (5), in their early examination of gastric fluid, reported that the clinical correlation in 27 cases of cancer showed 10 false negatives, 7 suspicious, and 10 positive diagnoses.

During the last year in the Gastroenterology Clinic at Hahnemann Hospital we have employed this method routinely in all cases in which gastric analysis has been done, the interpretation of the smears being performed by a physician especially trained for this work. So far the clinical correlation has been rather discouraging; we are hopeful it will be better with more experience.

Recently Papanicolaou (6) has expressed his view concerning the application of this method to gastric carcinoma, as follows:

"Special difficulties are encountered in the use of the smear method for the diagnosis of gastric carcinomas. Of these the two most important are the relatively rapid deterioration of exfoliated cells in the gastric fluid and the continual emptying of the gastric contents into the intestines, which does not allow a sufficiently large accumulation of exfoliated cells within the stomach. Another adverse factor is the rather frequent presence of extraneous cells in the gastric fluid. Clusters of cells from the nasal and bronchial mucosa and dust cells are those apt to be the most troublesome.

"Despite these drawbacks the cytologic method is of recognized value in the diagnosis of gastric carcinomas. By improving our cytologic criteria and our technical procedures we hope to bring this application up to much higher standards, although the percentage of false negatives will most likely remain higher in this than in other applications."

## CONCLUSIONS

The internist should ever be mindful of cancer of the stomach when a patient over thirty-five years of age complains for the first time of gastric symptoms which are not readily explained on some other basis and when such symptoms fail to respond to proper treatment. Gastric analysis and x-ray examination should be advised in every such case. Gastroscopy and study of the exfoliative cytology are valuable aids, have rather definite limitations, and should be considered as supplementary to the x-ray examination and gastric analysis. Only by early diagnosis can the rate of cure be increased and the survival time be prolonged.

235 North Fifteenth St.
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## REFERENCES

1. BOCKUS, HENRY L.: Gastro-Enterology. Philadelphia, W. B. Saunders Co., 1944, Vol. I.
2. DAILEY, M. E.: Role of Cancer-Prevention Clinics in Detection of Early Gastric Cancer. J. Nat. Cancer Inst. **7:** 375–377, April 1947.
3. ST. JOHN, F. B., SWENSON, P. C., AND HARVEY, H. D.: Experiment in Early Diagnosis of Gastric Carcinoma. Ann. Surg. **119:** 225–231, February 1944.
4. WIRTS, C. W.: Gastroscopic Diagnosis of the Location and Extent of Gastric Cancer. Gastroenterology **11:** 861–872, December 1948.
5. PAPANICOLAOU, G. N., AND COOPER, W. A.: Cytology of the Gastric Fluid in the Diagnosis of Carcinoma of the Stomach. J. Nat. Cancer Inst. **7:** 357–360, April 1947.
6. PAPANICOLAOU, G. N.: Survey of the Actualities and Potentialities of Exfoliative Cytology in Cancer Diagnosis. Ann. Int. Med. **31:** 661–674, October 1949.

SUMARIO

**El Papel del Internista en el Descubrimiento y Diagnóstico Temprano del Carcinoma Gástrico**

El factor más importante en el diagnóstico temprano del carcinoma gástrico es que el enfermo consulte al médico. El segundo factor en importancia es que el médico posea la comprensión y destreza profesional que le permita reconocer la posibilidad de la presencia de un tumor maligno y recomendar un adecuado estudio diagnóstico para determinar si hay presente tal lesión.

El internista debe pensar siempre en cáncer del estómago cuando un enfermo de más de treinta y cinco años de edad se queia por primera vez de síntomas gástricos que no se explican fácilmente de otro modo y si esos síntomas no ceden al tratamiento apropiado. En todos esos casos hay que aconsejar el análisis y examen roentgenológico del estómago. La gastroscopia y el estudio de la citología exfoliativa (método de Papanicolaou) constituyen valiosos auxiliares, pero muestran limitaciones bien definidas, de modo que deben ser considerados como complementos del examen radiológico y del análisis gástrico. Sólo mediante el diagnóstico temprano cabe aumentar la proporción de curaciones y el tiempo de sobrevivencia.

# Standard Radiologic Methods Used in the Search for Gastric Tumors[1]

FRED JENNER HODGES, M.D.

Ann Arbor, Mich.

THE RADIOLOGIC procedures first used for examination of the stomach, very nearly as old as the knowledge of x-rays themselves, are still found to be serviceable and, in fact, are being more widely used today than ever before. Basically these methods consist of fluoroscopic examination of the stomach before, during, and following the administration of opaque material in water suspension, as well as photographic recording of the roentgen appearance of the stomach under similar circumstances.

In the late teens and early twenties there were serious discussions regarding the relative merits of fluoroscopy and roentgenography. In those days Russell Carman was the outstanding proponent of fluoroscopy, which was entirely fitting since no American radiologist before or since his time has ever achieved greater dexterity or reliability in the fluoroscopic detection of gastric lesions. The supremacy of roentgenographic procedures in the matter of detecting gastric lesions was militantly argued by Lewis Gregory Cole, who substantiated his claims ably and brilliantly using the filming methods which he developed. Most of us who are engaged in the radiological aspects of gastroenterology have been content to borrow generously from both schools of thought, arguing to ourselves, correctly, that we can ill afford to deny ourselves the peculiar advantages of either approach. The old bone of contention has not been buried with finality, however, because no later than the last annual meeting of the Radiological Society of North America the relative superiority of fluoroscopy as compared to radiography in the examination of the gastro-intestinal tract was once more argued with brilliance and some asperity by Milo Harris, trained in the department once headed by Carman, and Frederic Templeton, an ardent devotee of mechanical devices for rapid spot-filming.

The rank and file of us are well content to continue to employ both methods concurrently in our practices. It is our common experience that the bulk of the lesions we discover are clearly demonstrable by either procedure. It has also been the experience of all of us, I am sure, that on occasion lesions have been found at the screen which we were not able to demonstrate with clarity roentgenographically, and conversely we have left the screen room convinced that no lesion existed only to find that film exposures made merely for purposes of record have brought to light undeniable signs of organic disease.

Because the basic principles involved in the roentgen diagnosis of gastric lesions have not changed, it does not follow by any means that the passage of time has failed to provide valuable improvements in the apparatus we use and the skill with which we employ it, based upon personally acquired experience and the published experience of others. Mechanical, electrical, and photographic improvements have materially contributed to the ease with which gastric lesions can be apprehended, and a voluminous literature on the subject is available to beginners in the field to offset in a very considerable degree their initial lack of personal experience.

The art of medicine as well as the science must be employed to the fullest if radiologic methods of gastric examination are to yield their fullest rewards. Certainly this is true in the case of fluoroscopy, where the winning of the patient's confidence and co-

[1] From the Department of Roentgenology, University of Michigan, Ann Arbor, Mich. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

operation at any cost is a primary rule for success. It is imperative that the examiner entrusted with the task of employing fluoroscopy to determine the status of the stomach shall devote his complete and undivided attention to the job. Above all else, he must be chronically suspicious to the extent that he will never be content to terminate screen examination until he has found a lesion or until he has convinced himself, on the basis of direct observation, that no lesion exists. He must assume that every stomach harbors an important lesion until innocence can be proved.

In the case of the radiographic approach, it is not enough to feed barium and film the stomach in blindly routine fashion, for the simple reason that better methods are available and no excuse can be tolerated for not employing them. Multiple positioning to take full advantage of the double contrast afforded by the residual gas bubble in the stomach can be most helpful, particularly in the demonstration of lesions which are so located as to be hidden in the classical right anterior oblique prone projection. The intimate combination of fluoroscopy and radiography in the procedure of spot filming owes much of its success to both basic methods.

Fundamentally, radiologic examination of the stomach is a crude procedure compared with direct inspection of the organ at the operating table, in the hands of the gross pathologist or the histopathologist, or by means of gastroscopy. The fluoroscopic images at which we peer, using to a large extent our peripheral fields of vision, are sadly lacking in clarity and definition. We never see lesions themselves but rather the modifications which they produce, whether large or small, of the shadows cast by opaque material introduced into the lumen of the organ. This opaque material itself, if used in amounts which are too generous, will quickly conceal the very signs for which we search. It is often true that very slight variations in the direction of projection result in the concealment of important diagnostic signs.

Unlike our colleagues in other specialties, we hesitate to demand that our impressions be accepted without supporting objective proof. As a matter of interest, the cardiologist sometimes prepares sound tracings to record the timing, the volume, and the wave form of the cardiac murmurs which he hears, but he recognizes no responsibility to do this as a routine procedure, nor is this demanded of him as a consultant. It is possible to photograph in color the appearance of the human retina, but in my experience ophthalmologists are not called upon to produce such pictures in support of their retinoscopic findings. The cystoscopist, the bronchoscopist, and the gastroscopist look, observe, and report with no thought of responsibility in the matter of providing concrete, visible proof of their findings. We, on the other hand, have volunteered over the years to document with film evidence our opinions regarding the stomachs we are called upon to examine. To our disadvantage, in many respects, we are slaves to a practice for which we ourselves are responsible. Few indeed among our colleagues in other specialties are those who possess any clear understanding regarding the interplay of fluoroscopy and radiography in the establishment of a diagnostic opinion. The practice of documenting opinions regarding the status of the stomach is not without advantage, however, for the effort to reproduce significant findings in photographic form is a constant stimulus to greater diligence at the screen and improved excellence of roentgenographic reproduction.

With all of its crudity, radiologic examination of the stomach still reigns supreme as the procedure of greatest dependability in the search for gastric lesions. Certainly it should be used to the fullest extent possible in conjunction with historical information regarding the patient's symptomatology and past medical experiences, the recorded findings of general physical examination, the information to be obtained on the basis of gastric acidity determinations, the microscopic study of gastric washings for telltale signs of intrinsic neoplasm, and the information to be acquired

by the employment of gastroscopy. There is no real room for an attitude of competition, since all of these methods are rightfully employed in the service of patients in whom gastric disease is suspected. Radiology enjoys a sound reputation on the basis of past achievements. In so far as statistical evaluations of diagnostic accuracy are valid, it is safe to say that with our form of examination we are able to detect a lesion in approximately 95 per cent of all patients with subsequently proved gastric carcinoma. No procedure capable of performance of this order of accuracy can be ignored, and thus our daily load of such examinations continues to be heavy.

It is paradoxical that detection of a primary gastric neoplasm may be one of the simplest diagnoses which a radiologist is called upon to establish. Fundamentally, he is looking for but one thing, defective filling of the gastric lumen. When, as is so often the case, a gastric neoplasm produces obvious and extensive deformity of the organ, this state of affairs is readily recognizable before the patient has completed drinking his opaque potion. The majority of gastric neoplasms are to be found in the lower third of the stomach and, because of this location, some degree of obstruction to the gastric outlet is commonplace. Furthermore, lesions in this locality are readily accessible to the examiner's palpating hand, permitting him to compress the organ sufficiently to vary the amount of opaque material in that portion of the lumen. He is sometimes fortunate in being able to combine vision and touch in the recognition of an intrinsic gastric abnormality if the lesion lies low in the stomach. We have called the simplicity of the recognition of gastric neoplasm a paradoxical situation and very rightly so, because, to offset the many neoplastic defects which are encountered simply and without great effort, many situations are encountered in which tumors, though present, are extremely difficult to apprehend. It is noteworthy that, despite the high percentage of diagnostic accuracy which radiology has achieved in this field, many and many a lesion primary in the stomach is to be discovered only if the observer has been alert and attentive as the very first barium enters the stomach and pours or trickles down the walls of the collapsed organ. This is particularly true in the case of lesions located high in the stomach, and bitter experience teaches the fluoroscopist that it is of the utmost importance to have his attention closely centered on the cardiac orifice as the first barium enters. It is axiomatic that errors of omission are commonplace when lesions of the cardiac portion are concerned. Errors of commission are made most frequently in the evaluation of the appearance and behavior of the lower third of the organ. High in the stomach palpation is of greatly limited value, and it is here that the ingenuity of the examiner is taxed to the fullest in order to make proper use of advantageous positioning and the use of his spot-film device.

Some lesions of vital importance to the patient are extremely small and insignificant. In these, where the difficulty of producing tangible, factual photographic evidence of its existence is the greatest, the need for such photographic proof is most imperative if the physician primarily entrusted with the care of the patient is to be convinced of the importance of our findings. We must be concerned with any fixed deformity of filling, however small and elusive. We must strive with the limited efficacy of our methods to determine which gastric ulcers are in reality ulcerations within pre-existing neoplasms for, depending upon our opinions and our warnings, lesions of this type may be treated expectantly or radically. Experience teaches that it is better to err by fearing neoplasm than to hope for benignity of an ulcer. Through the practice of repeated examinations the response of ulcers to medical management can be effectively gauged by us.

Radiologic examination of the stomach is a stimulating experience for the radiologist, despite the tragedy which so often stalks in the wake of his findings, because every patient presents a new diagnostic

problem for him to solve. Complacency in one's ability as a diagnostician in this field is not long maintained by any one, for the slightest deviation from stellar performance may lead to glaring error.

Standard radiologic methods used in the search for gastric neoplasm, though numerous and varied in expression, are based fundamentally on the simple principle of producing an unnatural degree of contrast between the walls of the stomach and the lumen of the organ which can be detected easily in a projected beam of x-rays. By means of this simple device, deviations from the expected state of affairs can be recognized in a surprisingly high percentage of patients when primary neoplasm is present. Refinements of existing procedures are always welcome and fortunately these are constantly being introduced. There seems to be little likelihood that any development in the near offing will relieve radiologists of the laborious and at the same time exhilarating procedure of upper gastro-intestinal tract examination.

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SUMARIO

**Técnicas Radiológicas Usadas Corrientemente en la Busca de los Tumores Gástricos**

Los métodos radiológicos aceptados que se emplean en la pesquisa de las neoplasias gástricas, aunque numerosos y variados en forma, se basan fundamentalmente en el sencillo principio de crear, entre las paredes y la luz del estómago, un contraste exagerado que pueda distinguirse fácilmente en un haz proyectado de rayos X.

En resumen, hay dos procedimientos: la fluoroscopia o roentgenoscopia, antes de, durante, y después de, la administración de un medio opaco, y el registro roentgenográfico del aspecto del estómago en circunstancias semejantes. Aunque ha habido sus diferencias de opinión acerca del relativo valor de las dos técnicas, la mayor parte de los radiólogos las utilizan las dos conjuntamente.

En realidad, el examen radiológico del estómago viene a ser un procedimiento tosco, comparado con la inspección directa del órgano por el cirujano, patólogo o gastroscopista, pues el radiólogo jamás ve las lesiones mismas sino meramente las modificaciones que producen o las sombras lanzadas por la sustancia de contraste. A pesar de todo esto, el examen roentgenológico del estómago todavía reina supremo como procedimiento de la mayor fidelidad en la busca de lesiones gástricas.

# Examination of the Stomach by "Oil Contrast"[1]

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DOUBLE-CONTRAST examinations with air as the transparent medium have become part of the accepted technic of study of the colon. On the contrary, double-contrast examinations of the stomach have not found general favor. Several methods have been advocated for gastric double contrast: one of the simplest, which occasionally gives excellent results, utilizes the air normally contained in the gastric air bubble and shifts it about the stomach by positioning of the patient. It may be well to emphasize that this simple expedient succeeds in about 20 per cent of the cases, provided the amount of barium is not excessive. In the remaining 80 per cent, the amount of intragastric air is not sufficient and must be supplemented by other means. The methods more frequently employed involve the use of effervescent powders or direct insufflation by means of a stomach tube. Both of these methods are generally unhandy, the quantity of gas cannot be easily controlled, and a few belches suffice to destroy the double contrast. Another method uses a thin rubber balloon inflated in the stomach following the ingestion of barium. Inflated balloons, however, have a shape of their own which may not conform to the shape of the stomach. The objectionable features and the limited applications of these various methods have kept gastric double contrast from general use.

A good method of gastric double contrast should not cause discomfort to the patient, should not require pharyngeal anesthesia, should control the amount of gastric distention, and should be susceptible of being used as a routine. An acceptable method was found when a patient who had taken two ounces of mineral oil following a barium study of the stomach[2] had to be called back for additional fluoroscopy. It was noted then that some barium formed an opaque coating on the mucosa, the oil provided double contrast, and the excess barium collected in a pool at the bottom of the stomach. By proper positioning of the patient, the barium pool could be shifted about, and the entire gastric mucosa studied by double contrast. This method was called "oil contrast." Up to the time of this writing, it has been used in over 1,000 patients following the usual fluoroscopic and radiographic examination of the stomach.

Oil contrast has several advantages: (1) Mineral oil is tasteless and easily administered in known amounts. (2) Patients will not belch mineral oil. (3) Mineral oil does not appreciably modify gastric peristalsis, tone, or emptying time. (4) Mineral oil does not appreciably change the function of the small intestine nor its mucosal pattern. (5) Oil contrast need not remain a "special" examination but may be done with ease and comfort whenever indicated. (6) Mineral oil is not expensive (about $1.00 per gallon).

Because of the layering of barium, oil, and air which occurs in oil contrast examinations, it would be desirable to study the stomach with horizontal rays. Unfortunately, the standard equipment permits fluoroscopy with horizontal rays only when the patient is upright. A satisfactory examination may be made, however, with the incident beam perpendicular to the tilting table if one proceeds as follows: (1) The patient is given 3 ounces of barium for the usual fluoroscopic and radiographic

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[1] From the Carle Hospital Clinic, Urbana, Ill. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

[2] The administration of 2 ounces of mineral oil has been our routine for several years to minimize the danger of barium impaction following gastro-intestinal examinations.

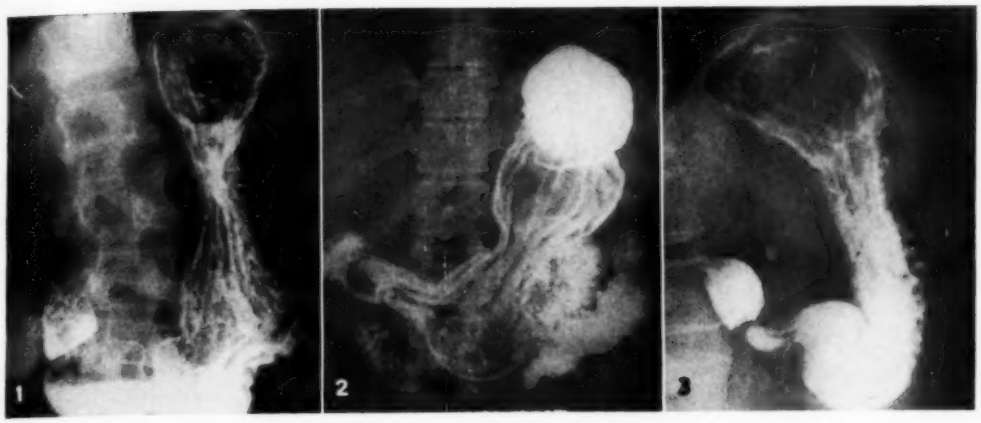


Fig. 1. Patient upright after ingestion of 3 ounces of barium and 3 ounces of mineral oil. Note fluid levels.
Fig. 2. Patient in Trendelenburg position. Note that the excess barium is now in the fundus. Oil contrast of the lower stomach.
Fig. 3. Patient prone and on right side. The excess barium is now in the distal portion. Oil contrast of the fundus.

study of the esophagus, stomach, and duodenum. He then drinks 3 ounces of mineral oil in the upright position. A good oil-contrast view of the body of the stomach as far as the barium level (Fig. 1) will be obtained with the patient upright, but unless he has been previously placed in the supine position, the fundus will not have the barium coating necessary for double contrast. (2) The distal portion of the stomach is visualized next by placing the patient horizontal on his left side and then rolling him slowly to a supine Trendelenburg position. This positioning causes the excess barium to collect in the fundus (Fig. 2) and shows the body and pyloric region in oil contrast. (3) The patient is then asked to lie prone and on his right side. The barium now collects in the distal portion of the stomach, and the fundus can be studied by oil contrast (Fig. 3).

The appearance of the normal stomach examined by oil contrast varies with the amount of filling. With 3 ounces of barium and 3 ounces of mineral oil, the mucosal folds are quite evident, and the appearance is not too dissimilar from that in compression films. When the amount of oil is increased to 6 or 8 ounces, the mucosa may be distended to the point where all folds disappear, and the stomach may present a completely smooth inner surface (Fig. 4). The possibility of studying the gastric mucosa at various stages of distention is rather intriguing and may serve to clarify some of the discrepancies between roentgen and gastroscopic findings.

Fig. 4. Patient in Trendelenburg position. Additional oil distends the stomach and obliterates the rugae.

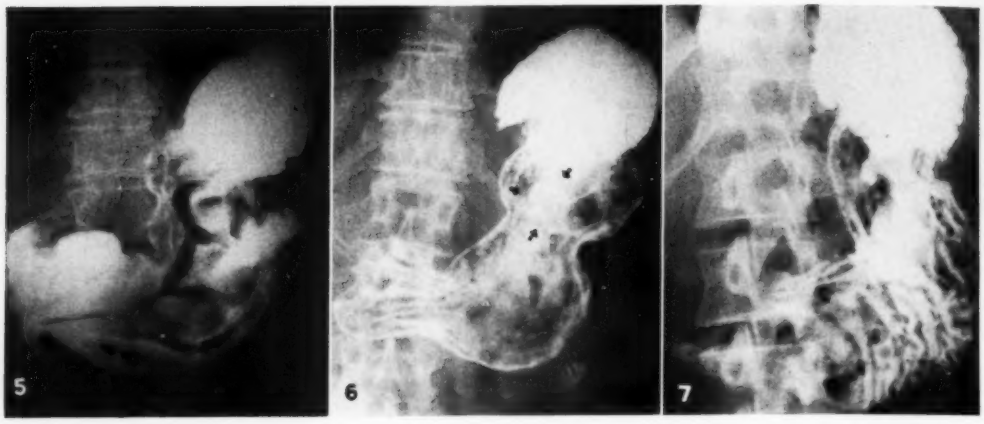

Fig. 5. Giant rugae.
Fig. 6. Polyp in body of the stomach.
Fig. 7. Ulcer crater. Note swollen rugae.

The fundus and the body of the stomach are usually well shown by oil contrast. In the distal part of the organ the procedure is often not so satisfactory, because of overlapping by the duodenal loop, overlapping by the spine, and possibly because of greater secretory activity of the prepyloric and antral mucosa. It is fortunate, therefore, that the distal portion is usually accessible to compression technic.

Several normal appearances may be confusing in oil-contrast films of the stomach: (1) The mucosa may have a granular appearance due to small air bubbles mixed with barium. (2) The mucosa may be patchy, as that seen in relief films when an excessive quantity of mucus is present. (3) Large oil or air bubbles in the barium coating may simulate polyps. (4) Barium drops in oil may simulate ulcer craters. (5) Thick mucous foam coated by barium may float at the junction of oil and air. All these appearances will disappear or be greatly modified by a change in the position of the patient. As mentioned above, the barium-filled duodenal loop is often a cause of annoyance because it is prone to cast its shadow on the lower stomach in the supine Trendelenburg position. Here fluoroscopy can be of help to dissociate intragastric and extragastric barium, but, if the case warrants it, it may be better to repeat the examination and obtain a good oil contrast of the lower stomach before any barium reaches the duodenum.

Oil-contrast examinations will not succeed in the presence of intragastric fluid.

Although not many pathologic conditions were encountered in the first eight months of experience with this technic, the lesions demonstrated by oil contrast have a familiar appearance, which resembles that shown by air contrast in the colon and by compression technic in the stomach, depending on the amount of gastric distention (Figs. 5–10).

Oil contrast will not show lesions of the pyloric region with the clarity of compression technic. Conversely, oil contrast has shown lesions in the higher portions of the body and in the fundus which had been previously missed or misinterpreted. It seems, therefore, that oil contrast and the other technics of roentgen examination of the stomach are complementary and not exclusive. Compression technic remains our best tool in the lower reaches of the stomach where one can palpate and compress. On the other hand, oil contrast can give us information about gastric areas which cannot be reached by compression, such as the fundus and the upper third of the body and also about those high stomachs which cannot be compressed because of the costal arch or excessive abdominal fat.

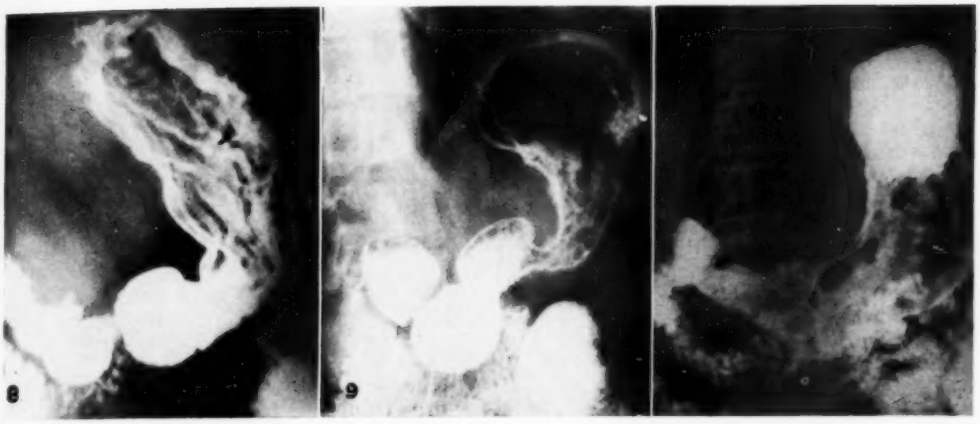

Fig. 8. Two ulcer craters in fundus, with swollen rugae.
Fig. 9. Linitis plastica of the lower half of the stomach. Note mucosal pattern.
Fig. 10. Atrophic gastritis (gastroscopic diagnosis).

SUMMARY

A method for the examination of the gastric mucosa called "oil contrast" is described. This depends upon the administration of 3 ounces of barium followed by 3 ounces of mineral oil. The procedure is particularly useful in those gastric regions which cannot be reached with the compression technic, *i.e.*, the higher portions of the body and the fundus.

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SUMARIO

**Examen del Estómago con Contraste de Aceite**

El método descrito para el examen de la mucosa gástrica y llamado "contraste con aceite" se basa en la administración oral de 90 cc. de bario, seguidos de 90 cc. de aceite mineral. Con el enfermo erecto, se obtendrá una buena vista con contraste de aceite del cuerpo del estómago hasta el nivel del bario, pero a menos que se le colocare antes en posición supina, el fondo no recibirá el recubrimiento de bario que es esencial para el doble contraste. Se visualiza después la porción distal del estómago colocando al sujeto horizontalmente del lado izquierdo y rotándolo lentamente a una posición de Trendelenburg supina, que hace que el exceso de bario se acumule en el fondo y revele el cuerpo y la porción pilórica del estómago en contraste de aceite. Luego se pide el enfermo que se recueste en decúbito prono del lado derecho; el bario se aglomera en la porción distal del estómago y puede estudiarse el fondo con contraste de aceite.

Este método resulta útil para el examen del fondo y el tercio superior del estómago, que no pueden alcanzarse con la técnica de compresión, y para el estudio de los estómagos altos que no pueden comprimirse debido a la presencia del arco costal o de excesivo tejido adiposo en el abdomen.

# The Histologic Characteristics and Growth Behavior of Primary Gastric Tumors[1]

W. D. STOVALL, M.D.[2]
Madison, Wis.

IT IS NECESSARY in a discussion of this kind to avoid the implications that stomach neoplasms are different histologically from neoplasms in other organs that have a similar tissue composition. Thus leiomyoma and leiomyosarcoma occur both in the uterus and in the stomach, and the organ of origin gives no mark of differentiation. As a corollary, the identification of the primary site of a tumor is often difficult and at times impossible on the basis of its histology alone. Gastric adenocarcinoma, for instance, is easily recognizable when the organoid arrangement of the cells is well preserved and it is known that the tissue has been removed from the stomach.

The well known metaplastic and anaplastic tendencies of tumors distort the cellular characteristics and the histologic picture. For example, with metaplastic changes, tumors of glandular origin may closely simulate epidermoid carcinoma (Fig. 1). Moreover, a highly anaplastic adenocarcinoma is not infrequently mistaken for a lymphosarcoma (Fig. 2). Special stains of the tissue shown in Figure 2B revealed the mucus-producing properties of the cells, and led to the diagnosis.

These histologic variations of tumors which perplex pathologists can be interpreted better when the whole pattern of gross anatomical deformity is known at the time of the histologic examination. Neoplasms of the stomach are no exception to this axiom. They produce local anatomical deformities which have led to the accepted classification of polypoid, ulcerating, sclerosing, and mixed types. In addition to local metastasis, the distant spread of the tumor may also be characteristic. The usual forms of metastasis are familiar—peritoneal seedings and the formation of rectal shelfing, involvement of the omentum and of lymph nodes, invasion of the thoracic duct, and the consequent development of the characteristic Virchow's node.

One type of metastasis, however, that is still not well recognized in spite of recurrent reports is the variety known as lymphangitic carcinoma of the lung (1). In this form, the spread occurs by direct invasion of the diaphragm, through the pleural to the peripheral pulmonary lymphatic channels. A similar metastatic pattern may be effected by hematogenous spread; and the same result may be produced by invasion of the thoracic duct, entry into the large veins, passage through the right heart, and the formation of tumor-cell emboli. Retrograde spread from the hilar lymph nodes is another pathogenetic possibility.

Gastric carcinoma with diffuse metastasis to the lung leads to sclerosis of the pulmonary vessels and fibrosis of the alveolar septa (Fig. 3). Patients may present themselves complaining of dyspnea, orthopnea, and cyanosis, and attention may be diverted from the gastro-intestinal system. In fact, in some instances death may occur with the clinical picture of cor pulmonale without the stomach lesion being recognized until postmortem examination, as was true in the case illustrated. While the stomach has been the primary site of the tumor in 75 per cent of reported cases of diffuse carcinomatosis of the lung with cor pulmonale, neoplasms in other organs —breast and prostate—occasionally give rise to the same condition.

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[1] Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

[2] Clinical Pathologist, State of Wisconsin General Hospital; Director, State Laboratory of Hygiene, Madison, Wis.

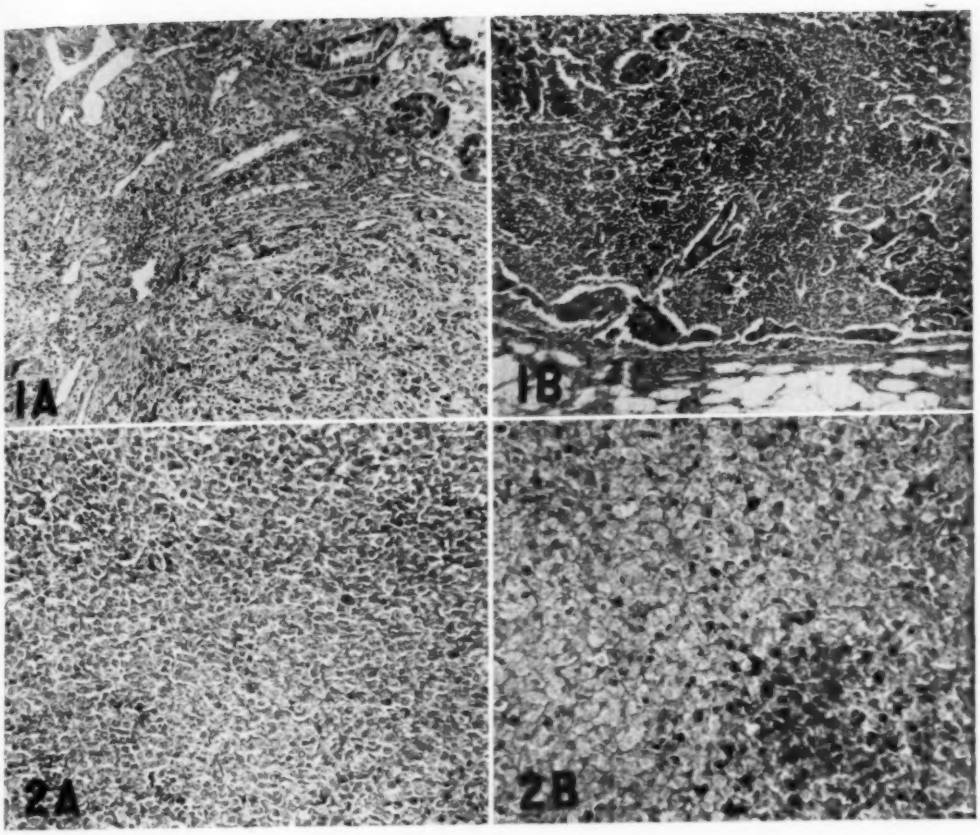


Fig. 1. A. Adenocarcinoma of the stomach, the lymph node metastasis of which (Fig. 1B) shows areas of squamous-cell metaplasia, simulating epidermoid carcinoma.

Fig. 2. A. Highly anaplastic neoplasm resembling reticulum-cell lymphosarcoma. B. Mucus-producing properties of cells shown by periodic acid leukofuchsin.

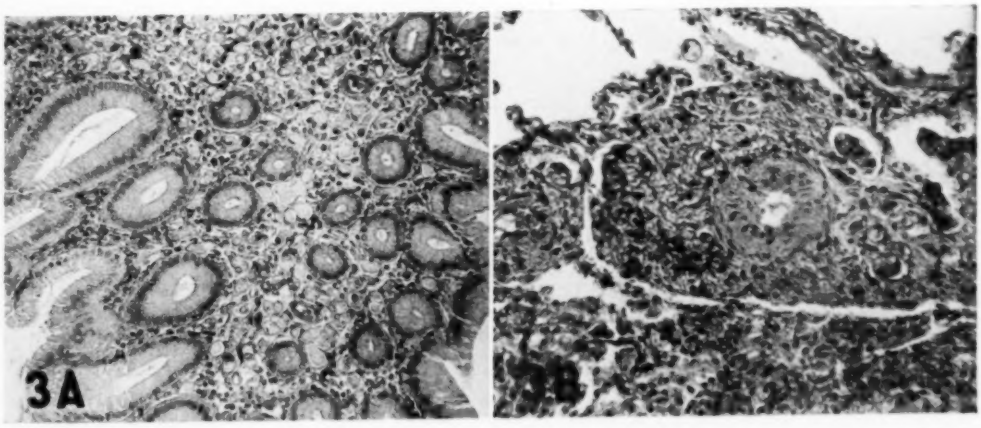


Fig. 3. A. Adenocarcinoma of the stomach. B. Metastatic involvement of the lung with sclerosis of pulmonary vessels and fibrosis of alveolar septa.

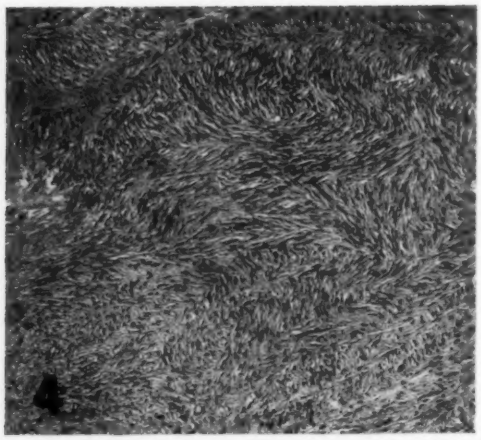

Fig. 4. Leiomyoma of stomach.

POLYPS AND ADENOMAS

Polypoid tumors may be either epithelial, arising from the mucous membrane, or mesothelial, arising from the muscularis or fibrous tissue elements. As is well known, adenomatous polyps are seen most frequently in the body and pyloric end of the stomach, but they may occur anywhere. They are not common but are prone to undergo malignant change. Of Stewart's (2) 322 cases of gastric carcinoma, 15 were associated with polyps. The incidence of adenomatous polyps and the frequency with which they undergo malignant change are difficult to determine because in the beginning the polyps are small and usually cause no pain or hemorrhage until a malignant tumor has developed. In this connection, the demonstration by Miller, Eliason, and Wright (3) in 1930 of early malignant changes taking place in 8 out of 35 cases of gastric polyps is significant.

Leiomyomas (Fig. 4) are polypoid tumors. They may be small or large and may protrude from the epithelial or serous surface of the stomach. They, too, are prone to develop into malignant tumors. The tumor is the same whether found in the stomach or in the uterus, except that in the stomach there is a greater tendency to malignant change. The differentiation of neurofibrosarcoma from leiomyosarcoma is sometimes clear-cut (Fig. 5), in other instances it is more difficult.

CARCINOMA

Evidence provided by the experimental production of cancer warrants the concept that cancer develops through a sequence of cellular changes. In the first stage it is characterized by the transformation of normal cells into pre-cancer cells. The second stage is one of proliferation, designated as pre-invasive carcinoma or *carcinoma in situ*. Reference has already been made to gastric polyps reported by Miller, Eliason and Wright. Bowen's disease in the skin and adenoma malignum of rectal polyps are other examples of this stage. The last stage is one of frank invasion, cancer. Since cancer is a histologic alteration of cells, it seems likely that it develops over a relatively wide area of gastric mucosa. It is probable, therefore, that while one field may be in the period of transforming normal cells into pre-cancer cells, another area may be in the proliferative stage or tumor stage, and another in the progressive or invasive stage. Willis (4) has expressed this point of view in his recent book, and Ewing (5) earlier observed changes which can be so interpreted. This concept is important to the surgeon, who is anxious to get not only beyond the tumor in his excision but also beyond the field of precancerous cells.

The classification of malignant neoplasms of the stomach on the basis of gross anatomical change represents an advanced stage of the disease. At this stage the polypoid, ulcerative, sclerosing, and mixed types previously referred to are recognized. The histologic classification recognizes the functional activity and the arrangement of the cells in such terms as gelatinous and signet-ring adenocarcinoma. Figure 6A shows a gelatinous carcinoma in which the epithelial cells are filled with mucus, and Figure 6B shows a section of a characterisitic signet-ring-cell type of metastatic adenocarcinomatous involvement of the ovary. Figures 7A and 7B show medullary and scirrhous carcinomas. Such prefixes do

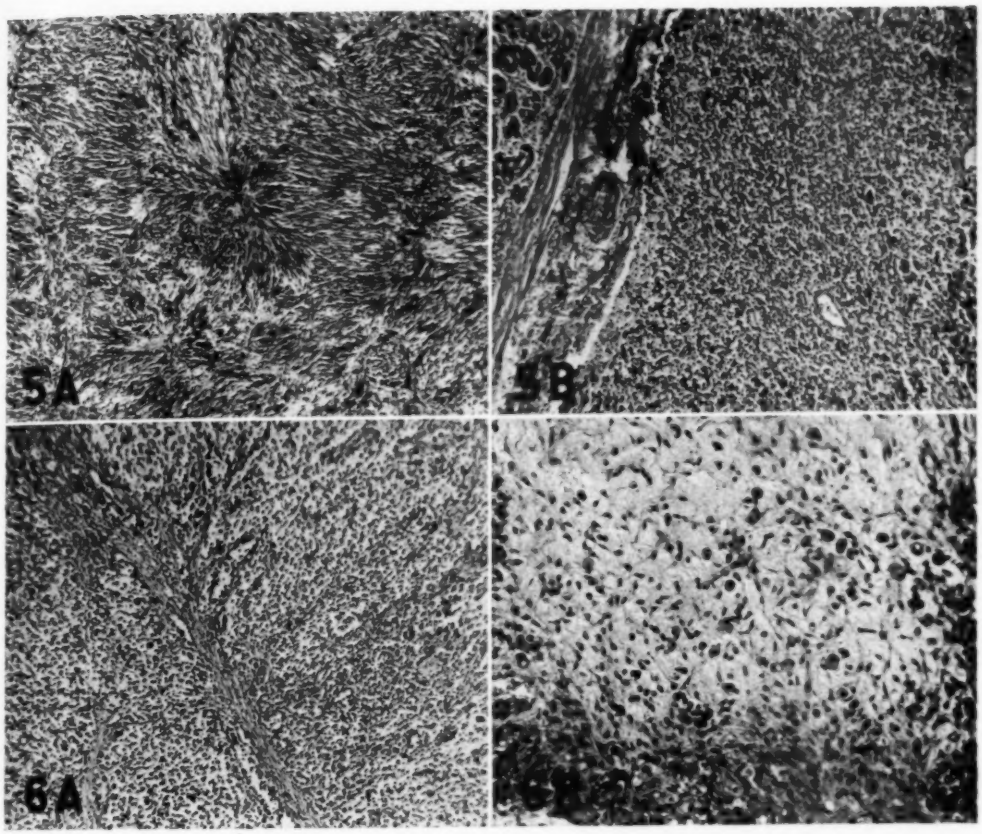


Fig. 5. A. Neurofibrosarcoma of stomach. B. Leiomyosarcoma of stomach.
Fig. 6. A. Gelatinous carcinoma of stomach. B. Characteristic signet-ring cells in metastatic involvement of ovary.

not modify in any sense the fact of malignancy or the potentiality of spread. Stout (6) discouraged the use of descriptive prefixes to carcinoma as "not only a waste of time but also deceptive."

### LYMPHOSARCOMA

The nomenclature of lymphomatous tumors has been the subject of numerous polemics, and it is not my purpose to review these debates. Suffice it to say that the classification into lymphosarcoma, giant-follicle lymphoma, reticulum-cell lymphosarcoma, reticulo-endothelioma, and leukemic nodes arose from attempts to make sharp differentiation of the various cell types. It is now recognized that these names represent not different cellular types but varying degrees of differentiation. All are sarcomas. However, since the nomenclature indicates the degree of differentiation rather than a genetic difference in the cells, it does imply the proliferative possibilities of the tumor. Here again the pre-invasive stages (giant-follicle lymphoma) are evident.

The site of origin of this group of neoplasms is not always apparent. Because the cervical nodes are often the first ones noticed, this does not mean that they are the ones in which the disease was initiated. The literature records, however, that the cervical, abdominal, and mediastinal nodes are most frequently the first involved. The lymphoid tissue of the stomach and intestinal tract are often the primary site.

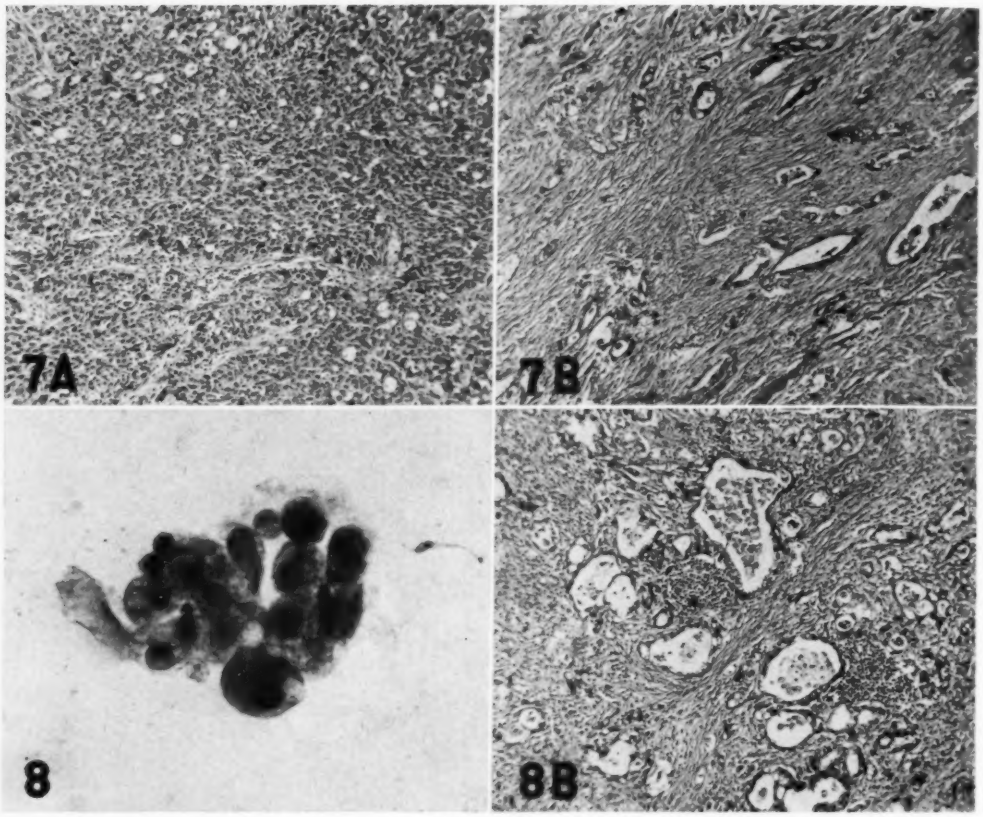


Fig. 7. A. Medullary carcinoma of stomach. B. Scirrhous carcinoma of stomach.
Fig. 8. A. Malignant cells in smear of gastric aspirate, stained by Papanicolaou procedure. B. Lymph-node biopsy from same patient, showing metastatic adenocarcinoma.

### GRADING MALIGNANCY

In a general way the histology of a tumor does afford an idea as to the degree of its malignancy, the rapidity with which it will develop, and the likelihood of early metastasis. The anaplastic tumors have a more rapid course and invade and metastasize earlier than those in which the normal architecture and characteristics of the cells are reproduced, but the variations of these qualities in different portions of the same tumor limit the value of grading methods for clinical use.

### GASTRIC ULCER AND CANCER

The relation of gastric ulcer to cancer has attracted the attention of radiologists, surgeons, and pathologists for many years. The question is still unsettled. Stewart's (2) statement is as good as any, namely, that it is impossible to say how often chronic gastric ulcers become malignant. In his own series of 227 operated ulcer cases there were 17, or 6.1 per cent, which showed evidence of malignancy. He concluded, however, that the incidence must be lower than this in view of the frequency of healed ulcers. But the significance of ulcer as a precancerous lesion becomes more impressive when viewed from the cancer side of the question. In 109 of Stewart's operated cancer cases, the site of origin was discovered to be in an ulcer in 17, or 15.6 per cent. To reiterate, while the incidence of malignant transformation in gastric ulcer appears to be below 5 or 6 per cent of

all ulcers, the fact that 15.6 per cent of 109 gastric carcinomas developed at the site of a simple ulcer creates a different point of view.

Since the greatest difficulty in connection with this question arises from a lack of knowledge of the early phases in the development of gastric neoplasms, technics designed to detect early malignant change may be helpful in the solution of the problem. In this respect, it is hoped that the Papanicolaou technic may afford the answer so long awaited (Fig. 8).


## SUMMARY

The tissue of origin determines the microscopic appearance of neoplasms in the stomach as well as elsewhere in the body. The organ in which a tumor is primary, as well as its histologic characteristics, determines the anatomical deformities, metastatic pattern, and other physical evidences of its presence.

The recognition of the primary site of a tumor often cannot be determined by its histology alone, and in anaplastic tumors even the tissue of origin is in question.

Although the proliferative possibilities of a tumor are portrayed in the degree of maturity which the cells have attained, the grading of tumor malignancy on this basis has only a limited usefulness in clinical practice because of the variation of this quality within the same neoplasm.

The relation of gastric ulcer to the development of cancer is difficult to determine; but its significance as a precancerous lesion is not negligible.


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## REFERENCES


1. MORGAN, A. D.: Pathology of Subacute Cor Pulmonale in Diffuse Carcinomatosis of the Lung. J. Path. & Bact. **61:** 75–84, January 1949.
2. STEWART, M. J.: Precancerous Lesions of the Alimentary Tract. Lancet **2:** 565–572, 617–622, 668–675, 1931.
3. MILLER, T. G., ELIASON, E. L., AND WRIGHT, V. W. M.: Carcinomatous Degeneration of Polyp of Stomach. Report of 8 Personal Cases with Review of 24 Recorded by Others. Arch. Int. Med. **46:** 841–878, November 1930.
4. WILLIS, R. A.: Pathology of Tumours. St. Louis, C. V. Mosby Co., 1948, pp. 110 and 115.
5. EWING, J.: Neoplastic Diseases. Philadelphia, W. B. Saunders Co., 4th ed., 1940, p. 22.
6. STOUT, A. P.: Pathology of Carcinoma of the Stomach. Arch. Surg. **46:** 807–822, June 1943.



## SUMARIO

### Las Características Histológicas y el Comportamiento de los Tumores Gástricos Primarios en su Desarrollo

El tejido de origen determina el aspecto microscópico de las neoplasias en el estómago lo mismo que en otras partes del cuerpo. El órgano en el que el tumor es primario así como las características histológicas determinan las deformidades anatómicas y el patrón metastático y otros signos físicos de la presencia del mismo.

El asiento primario de un tumor a menudo no puede ser determinado exclusivamente por la histología, y en los tumores anaplásticos hasta el tejido de origen queda en duda.

Si bien las posibilidades proliferantes de un tumor quedan indicadas por el grado de madurez que las células han alcanzado, la clasificación de la malignidad del tumor sobre esa base no posee más que utilidad limitada en la práctica clínica, debido a las variaciones de dicha propiedad en la misma neoplasia.

Es difícil determinar la relación de la úlcera gástrica con la cancerogenia, pero la importancia de la misma como lesión precancerosa no tiene nada de menospreciable.

# Present Status of the Surgical Treatment of Gastric Tumors[1]

CARL A. MOYER, M.D., and S. L. CLAYTON, M.D.

Dallas, Texas

THE PRESENT status of the surgical treatment of gastric tumors is a transitional one; therefore, it cannot be discussed without the inclusion of some historical background.

The first resection of the stomach of man was performed in 1879 by Jules Péan; the patient died. Two years later, Christian Billroth, knowing that resection of the stomach of animals was compatible with life, removed a large portion of the cancer-bearing stomach of Theresa Heller. She lived about four months and died with peritoneal carcinomatosis. Three years later, William Welch (18) analyzed the status of the surgical extirpation of cancers of the stomach as follows:

"Should resection of cancer of the stomach become a legitimate operation in surgery, it will be of the utmost importance to make the diagnosis in an early stage of the disease. Only those cases are suitable for resection in which there are no secondary deposits, the general health of the patient is in fair condition, and extensive adhesions have not been formed....

"In cases in which there is reasonable suspicion of the existence of gastric cancer, and in which there is proper ground to contemplate resection of the tumor, it is justifiable to make an exploratory incision into the abdomen. It can then be decided whether or not cancer exists, and whether the case is suitable for operation....

"*Prognosis:* There is no proof that cancer of the stomach has ever ended in recovery. It may be admitted that partial cicatrization of gastric cancer may occur. We have, however, no sufficient reason to believe that cancer of the stomach has ever been completely destroyed by any process of nature or by any medicinal treatment.

"A successful resection of a cancer of the pylorus by Billroth in January, 1881, made a great sensation in the medical world. Since that time the operation has been performed successfuly ten times, and with fatal issue twenty-seven times. A radical cure has not, however, been effected, although life has been prolonged for a year and a half after the operation.* The possibility of permanent cure of gastric cancer by extirpation must be admitted. Enthusiasm over this possibility, however, is seriously lessened by the fact that a radical cure is not to be expected unless the operation is undertaken when the tumor is of small size, has produced no distant metastases, is free from many adhesions, and the patient is not greatly prostrated. In view of the difficulty of diagnosis in the early stages, it is not likely that these favorable conditions can be fulfilled except in the rarest instances. Metastases may already exist when the tumor is small and before it has given rise to any symptoms. Pylorectomy, moreover, will probably be successful in the hands of only comparatively few surgeons. It is therefore but a feeble glimmer of hope which is now admitted to the hitherto relentlessly fatal forecast of this disease."

* Several of the patients are still living (1884), but, so far as I can learn, no patient has survived the operation more than a year and a half.

It is interesting that Welch first discussed the surgical removal of gastric cancer under *Prognosis* and then, under the heading *Treatment*, wrote:

"While all specific treatment of gastric cancer is to be abandoned, much can be done for the relief and comfort of the patient. The treatment is symptomatic."

Farther along he again discusses the role of surgery as follows:

"Discussion of the surgical treatment of gastric cancer of course does not belong to this work. The opinion entertained by the physician as to the propriety of surgical interference in gastric cancer is not, however, a matter of indifference, for cases of gastric cancer come first into the hands of the physician, and generally only by his recommendation into those of the surgeon. So long as the physician stands absolutely powerless before this disease, his general attitude as to the propriety of surgical interference should not be one of hostility. Experience only can determine the justification of surgical operation in cases of gastric cancer. As yet it is too soon to express a positive opinion as to the value of resection of gastric cancer. Of 37 published resections of cancer of the pylorus, 27 died from the effects of the

[1] From the Department of Experimental Surgery, the Southwestern Medical School of the University of Texas, Dallas, Texas. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

operation, and of the fatal cases 18 within the first twenty-four hours. These results are certainly not calculated to awaken much enthusiasm for the operation. Still, it would be wrong to draw definite conclusions from the existing statistics of resection of the cancerous pylorus, partly because the number of operations is as yet too small, partly because the operation has been done when it was certainly unwarrantable according to the best judges (Billroth, Czerny), and chiefly because the number of operators in proportion to the number of operations is too great. For the 37 published operations there have been 27 operators. Ovariotomy was not considered a justifiable operation until the excellent results of individual operators were obtained. It is probable that to an even greater extent resection of the pylorus will become the specialty of certain operators. Therefore, before concluding as to the value of resection of cancer of the stomach it is necessary to await the results of individual surgeons in a series of cases."*

* Already, from this point of view, the operation appears more hopeful. Czerny has performed 6 resections of the stomach with only 2 fatal results; 4 of the operations were pylorectomies for cancer. Billroth has performed the operation 8 times with 3 fatal results (Wiener med. Wochenschrift, 1884, Nos. 17 and 29).

The progress that has been made since 1884 can most readily be depicted by showing what has happened to the reasons that Welch used as a basis for his assumption that the operative removal of gastric cancer would have a very limited usefulness. The reasons for his assumption are summarized by Livingston and Pack (6):

*Initial Estimate on Value of Gastrectomy*
*(William Welch, 1885)*

A. Can never be applicable except in rarest case.
B. Offers but glimmer of hope to hitherto relentless forecast of this disease.

1. Cost to life: 37–90 per cent mortality.
2. Failure to cure: Survivors died within one and one-half years.

Six Reasons Why Not Applicable to Average Case:

1. Distant metastases when first seen.
2. Location may prohibit removal (cardia).
3. Extent may prohibit removal (plastica type).
4. Widespread adhesions to pancreas and colon.
5. Extreme debility of patient.
6. Specially trained surgical team needed.

Let us now consider what has happened to some of the Welch postulates during the last sixty years.

*I. Resection can never be applicable to carcinoma of the stomach except in rarest cases* (Welch): Welch had already presented data that refuted the above statement. The autopsy reports of Habershon, Lebert, Gussenbauer, and von Winiwarter collected by Welch (18) showed that in 410 of 1,120 cases of gastric cancer there were no distant secondary deposits at the time of death. In other words, in Welch's time, 37 per cent of those dying from gastric cancer still had the disease restricted to the stomach and its attached lymph nodes. Therefore, they could have been considered as satisfactory candidates for resection. The influence of the first Welch dictum must be considerable still, because in 1939 Livingston and Pack wrote "necropsy findings on those dead of gastric cancer have established the fact that over 20 per cent of individuals at the time of death from the disease are even then free of any evidence of distant metastases and have a type of cancer which to the very end is still confined to the stomach, or to the stomach and immediately adjacent nodes."

Should we assume that the City of Detroit is fairly representative of the country as a whole, then the attempted resection rate does not begin to approach the lowest possible resection rate—that which exists on the autopsy table. In Detroit, between 1927 and 1929, only 7.7 per cent of those with gastric cancer had gastric resections performed (13). Contrast this figure with the possible postmortem resection rate of 37 per cent (Welch). Why should this discrepancy exist? There are many reasons, among the most important being (1) the limited ability of the general operator[2] and (2) the profound defeatist attitude toward cancer of the stomach that is held by many surgeons, general practitioners, internists, and radiologists.

What happens to the applicability of gastric resection to the treatment of carcinoma of the stomach as these reasons are voided? Figure 1, which is constructed

[2] He who undertakes to explore the abdomen of an individual having a gastric cancer should be capable of performing a total removal of the stomach together with the spleen and a part of the pancreas and colon, when there is need to do so.

from data of Wangensteen (14) and Pack and McNeer (12), answers this question.

*II. Gastrectomy offers but a glimmer of hope to hitherto relentless forecast of this disease* (Welch): As the resectability of gastric carcinoma has been extended, the ratio of the number of five-year survivals to the number of resections has remained practically unchanged (6).

One may expect that of 100 people leaving the hospital after the resection of a carcinoma of the stomach, 33 will live three years, 25 will live five years, and 20 will live ten years (6). During these time periods one may expect that of 100 individuals not suffering from carcinoma of the stomach, 90 will live three years, 87 five years, and 66 ten years (6). When account is taken of this death expectancy from "natural causes," the 20 ten-year postresectional survivals represent a ten-year curability of gastric carcinoma of 30 per cent.

The rapid increase in resectability in selected areas is due primarily to technical advances and secondarily to advances in diagnostic methods and to adoption of exploratory celiotomy as the only way of determining operability except when there is certainty of distant spread. Earlier diagnosis cannot account for much of it, because the diagnosis of gastric carcinoma is not being made appreciably earlier during the present decade than it was in the preceding one (17).

Obviously, gastric resection offers more than a "glimmer of hope" to the hitherto relentless forecast of the disease.

*III. The cost to life: 37 to 90 per cent mortality* (Welch): The operative mortality has been falling steadily as time passes. See Figure 2.

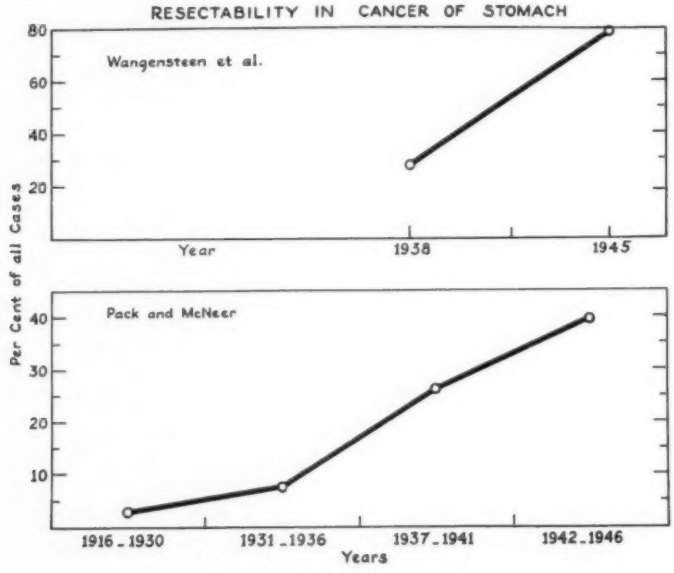


Figure 1

*IV. Location may prohibit removal (cardia)* (Welch): Sweet's data answer that postulate, namely 86 cases of gastric carcinoma invading the cardia and lower esophagus resected, with an operative mortality of 11.6 per cent (15). Prior to 1936, carcinomas of the cardia of the stomach and esophagus were held to be inoperable.

*V. Extent may prohibit removal (plastic type)* (Welch): Forty-three total gastric resections were performed at the Memorial Hospital for Cancer and Allied Diseases (New York) between 1937 and 1947 (11). The operative mortality was 34 per cent.

The mortality is relatively high, but it will drop.

Coller (3) reported 19 total gastric resections with only 2 operative deaths. Longmire (7) performed 20 total resections with 2 operative deaths.

"Cure" rates following cardiectomy and total gastric resection cannot be ascertained. The procedures are yet too young and the operations too few. However, the extent of involvement of the stomach no longer prohibits the removal of the cancer.

*VI. Widespread adhesions to the pancreas and colon* (Welch): The number of successful massive resections of carcinoma of the stomach invading the spleen, colon, and pancreas is rising steadily. Adhesions to surrounding organs no longer constitute inviolate barriers to the surgical extirpation of gastric carcinoma (2, 7).

*VII. Extreme debility of the patient* (Welch): Advances in parenteral and jejunal feeding technics have practically abolished this deterrent to gastric resection. With combined parenteral and jejunal feeding, flesh can be added to a starved man at the rate of a pound a day. Sustained in-puts of 5,000 to 7,000 calories *per diem* are now possible even though the pylorus is completely obstructed by a neoplasm.

Distant metastases when first seen are still fairly positive deterrents to resection. However, one should be sure that the "distant metastases" actually exist. A node in the neck, a hard umbilicus, a presumptive "rectal shelf," a nodular liver, and questionable ascites should be proved to be due to carcinoma. The node and the nodular umbilicus should be removed for microscopic examination; the ascites should be proved to be of neoplastic origin by direct means; the nodular liver may be cirrhotic and not invaded by the neoplasm. In other words, laparotomy should be employed to determine operability except when absolute evidence of distant metastases exists.

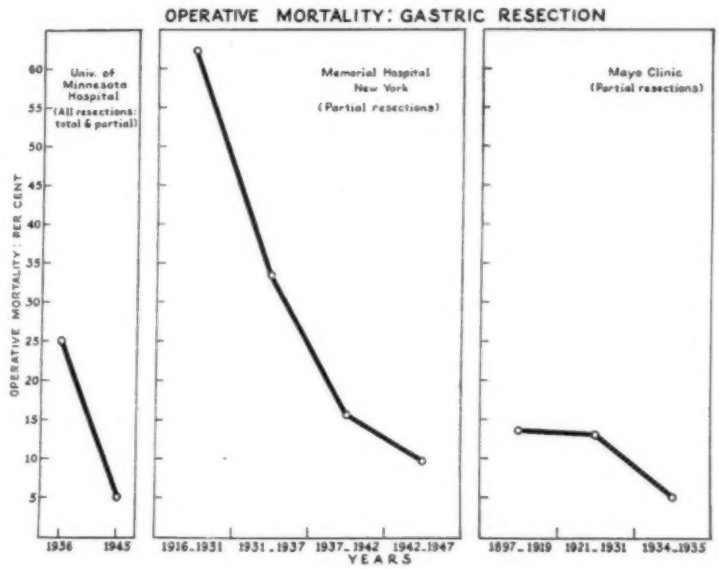


Figure 2

The picture of the role of surgery in the treatment of gastric cancer thus far presented is a bright one. It has been constructed from data collected under the most favorable circumstances. It is a true representation of the situation which exists in medical islands in the country, but the actual accomplishment throughout the

nation as a whole still supports practically all of the Welch dicta. The resection rate of gastric cancer in the Detroit area in the early 30's was 7.7 per cent and the mortality rate of resection was 61 per cent (13). The concurrent situation in the State of Virginia was judged to be even worse (4). A similar situation existed in New Orleans —a 5 per cent resectability with a mortality of 51.4 per cent; not one patient in two hundred lived longer than three years (8). It is likely that the above figures are true of the country as a whole today.

A simple numerical analysis of the bright and dark sides of the situation provides us with some remarkable data. Cancer of the stomach develops in about 40,000 to 50,000 people in the United States every year. Should the highest resectability rate reported (14) apply throughout the country, 32,000 to 40,000 resections[3] of gastric cancer would be performed each year and 1,600 to 2,000 patients would not survive the operation.[4] This would leave from 30,400 to 38,000 people to live out their life expectancy. Consequently, we could expect that 10,032 to 12,540 would live three years, 7,800 to 9,500 five years, and 6,080 to 7,600 ten years.

Should the resectability and mortality rates that we may presume to apply to the country as a whole be used as factors, then the following sets of figures provide the gross picture of gastric cancer in the United States today. Four thousand to 5,000 resections[5] are probably performed yearly; 2,000 to 2,500 patients[6] die of the operation, leaving only 2,000 to 2,500 people to live out their life expectancy. Therefore, 660 to 825 could be expected to live three years, 500 to 625 to live five years, and 400 to 500 to live ten years. These figures are in accord with the estimates made by Oughterson (10), who used the over-all picture of carcinoma of the stomach at New Haven as the basis for his estimate that no more than 1 to 2 per cent of all patients suffering from carcinoma of the stomach lived for five years. The bright and dark sides are shown graphically in Figure 3.

We may consider that the high resectability rates and low operative death rates that obtain in centers in this country represent the characteristics of pilot plant operation and attainable goals. Obviously the distribution of the surgical practices of the pilot plants throughout the country can make remarkable inroads into the conquest of gastric cancer. This will not be an easy matter. A fair number of well trained, adept, surgical teams must be trained, and to these patients having cancer of the stomach must be sent.

The treatment of gastric cancer cannot undergo rapid improvement as long as the resection of the cancerous stomach lies within an unrestricted surgical domain.

The training of a hundred surgeons in the technics of the extensive resections that must be performed if the pilot plant figures are to be approached throughout the country is in itself a formidable task. There are only a few American centers capable of providing the requisite training. Without the adoption of the trained team plan, little can be accomplished by effecting earlier diagnosis. High mortality rates and low resectability rates will obtain as long as the treatment of gastric cancer is forced upon the surgeon who performs less then twenty gastric resections yearly. Welch's conclusion, that a specially trained surgical team is needed if gastric cancer is to be treated as well as possible, is as true today as it was in 1884.

While enormous inroads into carcinoma of the stomach can be made by the application of well established surgical technics, additional progress toward the control of the disease can be effected by the adoption of certain attitudes by the American physician. Some of these attitudes are:

1. No man or woman having an anemia should receive treatment for it *until the cause of the anemia has been absolutely ascer-*

[3] Calculated upon the basis of 80 per cent resectability.

[4] Calculated upon the basis of 5 per cent operative mortality.

[5] Calculated on the basis of 10 per cent resectability (2.3 per cent added to the 7.7 per cent for Detroit or 5 per cent added to the 5 per cent for New Orleans).

[6] Calculated on the basis of a 50 per cent mortality rate.

*tained.* Far too many men and women still receive iron and liver when they suffer with an otherwise silent neoplasm of the gastro-intestinal tract. In our medical colleges too much emphasis is placed upon the diagnosis of the type of anemia and not enough emphasis is placed upon the fundamental causes thereof. The dollar laboratory examination for occult blood in the stool is worth more to the patient with cancer of the gastro-intestinal tract than a $50 consultation with a hematologist.

2. The general cancer consciousness of teachers of medicine with psychiatric and psychosomatic bents should at least be equal to their consciousness of the psychologic and emotional aspects of illness. It is remarkable that persuasive assurance is capable of erasing an internal neoplasm from somatic consciousness—until it grows too large to be removed from consciousness by manipulations of the psyche and too large to be extirpated by the surgeon.

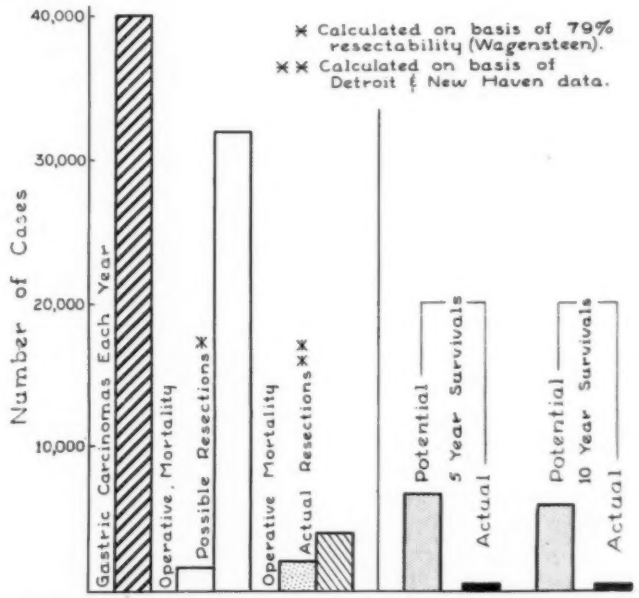


Fig. 3. What can be done for gastric cancer and what is being done.

3. The medical therapy of ulcerative lesions of the stomach should be undertaken with the realization that at least 12 per cent (17) of the symptomatically typical peptic ulcers of the stomach are really cancerous ulcers, and that most cancerous ulcers will respond symptomatically, a fair number will diminish in size, and many will actually heal temporarily when treated medically. Welch and Allen consider that gastric ulcer is a "surgical disease" because of its frequent confusion with cancer. Welch believes that immediate surgical intervention is indicated if the duration of the ulcer is short in a person over fifty, if it is on the greater curvature or in the prepyloric area, if it is over 2.5 cm. in width, if achlorhydria coexists, or if it is chronic and situated on the lesser curvature. A three-week trial period of medical therapy is warranted if the sufferer is young and the ulcer is of short duration, is small, and is on the lesser curvature. Healing should be complete within three weeks and healing must be maintained (adapted from Welch, 17).

4. Individuals having pernicious anemia are much more prone to develop cancer of the stomach than others not so afflicted. Eight per cent of persons having Addisonian anemia may be expected to be carrying a

cancer of the stomach, and an additional 7 per cent harbor benign premalignant polypoid gastric tumors (1). Regular examinations of the stool for occult blood and less frequent roentgen examinations of the upper gastro-intestinal tract must be considered as integral parts of the care given the patient with pernicious anemia.

5. All polypoid tumors of the stomach should be considered as malignant, or at least premalignant, until absolute histologic proof to the contrary has been secured. The really benign polypoid growths in the stomach are so rare that the possibility of their existence should never be used as the basis for deferring operative intervention.

The status of surgery in the treatment of lymphosarcoma of the stomach is about the same as in carcinomas of the stomach. A few long-term cures have been effected by surgery alone (16). Surgery should always precede roentgen therapy in order that a histologic diagnosis may be made, and, whenever possible, excision of the major gastric tumor should be done so that massive bleeding from the growth will not attend radiation or medical therapy.

This discussion may be summed up by saying that the status of surgery in the treatment of gastric cancer can be improved greatly by the extension to the country as a whole of the surgical technics now practised in medical centers.

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## REFERENCES

1. BENEDICT, E. B., AND ALLEN, A. W.: Adenomatous Polypi of the Stomach, with Special Reference to Malignant Degeneration. Surg., Gynec. & Obst. **58:** 79–84, January 1934.

2. BRUNSCHWIG, ALEXANDER: Radical Surgery in Advanced Abdominal Cancer. Chicago, University of Chicago Press, 1947.

3. FARRIS, J. M., RANSOM, H. K., AND COLLER, F. A.: Total Gastrectomy: Effects Upon Nutrition and Hematopoiesis. Surgery **13:** 823–833, June 1943.

4. HORSLEY, J. S.: Benign and Cancerous Gastric Disturbances: Cancer of the Stomach. Porter Lect., University of Kansas **3:** 39–56, 1934.

5. KAPLAN, H. S., AND RIGLER, L. G.: Pernicious Anemia and Carcinoma of the Stomach—Autopsy Studies Concerning Their Interrelationship. Am. J. M. Sc. **209:** 339–348, March 1945.

6. LIVINGSTON, E. M., AND PACK, G. T.: End-Results in the Treatment of Gastric Cancer: An Analytical Study and Statistical Survey of Sixty Years of Surgical Treatment. New York, Paul B. Hoeber, Inc., 1939.

7. LONGMIRE, W. P., Jr.: Total Gastrectomy for Carcinoma of Stomach. Surg., Gynec. & Obst. **84:** 21–30, January 1947.

8. MAES, U., BOYCE, F. F., AND MCFETRIDGE, E. M.: Tragedy of Gastric Carcinoma: Study of 200 Surgical Cases. Ann. Surg. **98:** 619–634, October 1933.

9. O'DONOGHUE, J. B., AND JACOBS, M. B.: Primary Lymphosarcoma of the Stomach: Statistical Summary and Case Report of a Five-Year Cure. Am. J. Surg. **74:** 174–179, August 1947.

10. OUGHTERSON, A. W.: End-Results in the Treatment of Carcinoma of the Stomach. Yale J. Biol. & Med. **4:** 711–728, May 1932.

11. PACK, G. T., AND MCNEER, G.: Surgical Treatment of Cancers of Gastric Cardia. Surgery **23:** 976–1019, June 1948.

12. PACK, G. T., AND MCNEER, G.: End-Results in the Treatment of Cancer of the Stomach: Analysis of 795 Cases. Surgery **24:** 769–778, November 1948.

13. SALTZSTEIN, H. C., AND SANDWEISS, D. J.: Problem of Cancer of the Stomach. Arch. Surg. **21:** 113–127, July 1930.

14. STATE, D., MOORE, G. E., AND WANGENSTEEN, O. H.: Carcinoma of the Stomach: 10-Year Survey (1936 to 1945 Inclusive) of Early and Late Results of Surgical Treatment at University of Minnesota Hospitals. J. A. M. A. **135:** 262–267, Oct. 4, 1947.

15. SWEET, R. H.: Carcinoma of Esophagus and Cardiac End of the Stomach: Immediate and Late Results of Treatment by Resection and Primary Esophagogastric Anastomosis. J. A. M. A. **135:** 485–490, Oct. 25, 1947.

16. TAYLOR, E. S.: Primary Lymphosarcoma of Stomach. Ann. Surg. **110:** 200–221, August 1939.

17. WELCH, C. E.: Carcinoma of the Stomach. S. Clin. North America **27:** 1100–1105, October 1947.

18. WELCH, W. H.: Cancer of the Stomach. System of Practical Medicine, edited by W. Pepper and W. Starr. **2:** 530–579, 1885. Philadelphia, Penna. Lea Bros. & Co.

## SUMARIO

### El Estado Actual del Tratamiento Quirúrgico de los Tumores Gástricos

Welch, hace unos sesenta y cinco años, poco después de la ejecución de las primeras resecciones gástricas, dió por sentado que la extirpación cruenta del cáncer del estómago tendría una utilidad muy limitada. A su entender, el procedimiento sólo era aplicable en rarísimos casos; no ofrecía más que un "destello de esperanza" a un alto precio en mortalidad; y su empleo en la mayoría de los casos no resultaba factible debido a la presencia de metástasis remotas, la localización (cardias) y exten-

sión de la lesión, las esparcidas adherencias al páncreas y al colon y la debilidad del enfermo.

Cítanse aquí datos recientes que tienden a refutar opiniones tan pesimistas, pero que sólo presentan el aspecto brillante del cuadro. Lo obtenido realmente en el país en conjunto ofrece considerable apoyo a los viejos postulados de Welch. El mejoramiento del puesto de la cirugía en el tratamiento del cáncer del estómago exige la extensión a la nación en conjunto de las técnicas operatorias hoy día practicadas en unos pocos destacados centros médicos. Cierta actitud de parte del médico ayudará también a lograr mejores resultados. Hácese hincapié en la importancia de la anemia como indicación de cáncer gástrico, la relación de la úlcera péptica y el carcinoma y la probable naturaleza maligna de la gran mayoría de los tumores polipoideos del estómago.

## DISCUSSION

(Papers by Brown; Hodges; Gianturco; Stovall; Moyer and Clayton)

**Leo G. Rigler, M.D.** (Minneapolis, Minn.): I have been very happy about this comprehensive symposium.

Several years ago I reviewed the various methods that one might use for the routine examination of the stomach in patients without symptoms and came to the conclusion that, at least for the time being, the conventional method which Dr. Hodges described is the only one that offered us accuracy, since we were not looking for the very gross tumors, which may also present problems, but for the small lesions which would be expected in individuals who are asymptomatic.

Despite the fact that we use this method of fluoroscopy, spot films, and routine series, we still are making errors, of which we are perfectly aware. I find it difficult to believe, therefore, that any procedure in which fluoroscopy alone is used or films alone, as in the photofluorographic method, will not produce a substantial percentage of errors.

Yet we find, of course, as everyone recognizes, that the general utilization of the conventional procedure is quite impractical and, for that reason, such innovations as that of Dr. Roach and Dr. Morgan are certainly most welcome.[1]

Much must be done. For instance, I notice they are re-examining, by the conventional method, approximately 33 per cent of their patients in whom nothing is found. This includes something over 8 per cent because of the unsatisfactory character of the photofluorographic examination and 24 per cent because of false positives. I am sure this can and will be reduced. However, let me point out that in the series we are doing, using gastric acidity as a filter, we are only examining about 30 per cent of all the patients in the selected age group, and we think we are finding at least 90 per cent of all the carcinomas in that group. Therefore, we are really doing less work than Dr. Roach and Dr. Morgan, because we are not submitting anyone to a preliminary examination, which they must perform.

In connection with this, let me point out that in our series of asymptomatic persons—I emphasize that because they are very carefully culled—in whom we have made the conventional type of examination, we have found 7 cases of carcinoma per 1,000. Since we examine but 30 per cent of the age group, we may spread the finding of that 30 per cent over the whole group; by this extrapolation we still find something better than 2.4 carcinomas per thousand, and these are in males and females over the age of forty-five.

I find it difficult, therefore, to accept Dr. Brown's figures of 1.4 in males over fifty, since the incidence in males is twice that of females and the incidence rises sharply between forty-five and fifty. I think our figures belie that, unless we were to assume that our incidence of cancer of the stomach may be greater because we are a predominantly Scandinavian and German population, and there is some evidence to support the theory that carcinoma is more frequent in such groups.

Let me point out, in addition, that our incidence of polyps in the stomach has been found to be approximately 8 per 1,000. Not all of these are proved, however, so I would be inclined to discount this figure. Some of them may be the small leiomyomas to which Dr. Stovall referred, but most of them have been proved by direct observation or by operation. If you were to examine a group of 1,000 individuals with symptoms, the ratio would not be so high, but in asymptomatic individuals that is what we have found.

I am in agreement with Dr. Moyer that the improved resectability at the University of Minnesota Hospital is largely due to improved technic but not entirely so. I think we deserve a little of the credit because, from the group of cases of pernicious anemia which we have been studying for ten years and the group of cases of low gastric acidity studied for the past five years, we have been able to furnish the Department of Surgery with a number of very small

[1] "Application of Mass Photofluorographic Methods for Surveying Large Population Groups for Gastric Tumors." Not submitted for publication.

tumors, and that I suppose has added somewhat to the resectability of the group as a whole.

I should say that we have also found a fair number of malignant polyps which were in the range of one or two centimeters in diameter and a fair number of infiltrating tumors which were in the range of one centimeter or thereabout.

Despite this relatively elaborate examination, we overlook some cases. Let me cite one case which I saw just before I came away, illustrating the difficulties.

A patient with pernicious anemia, whom I first examined in 1944, when the diagnosis was originally made, was found to have no gastric lesion. We lost track of him, but he returned five years later, in April of this year, and again was given the usual routine examination. One of my associates, a competent radiologist, did a fluoroscopic examination, made two spot films and a series of ordinary films, and called the results negative. Six months later the patient, still symptomless, came back for his next routine examination. We found an infiltrating carcinoma, extending from the esophagus well down to the antrum of the stomach.

We re-examined the films made six months earlier, and the lesion was there, measuring about 1.0 cm., but it was one of those instances where hindsight is always easier than foresight.

I cite this example to illustrate the fact that, if we were to examine this patient for the first time now, no error would be recorded. Since studying these symptomless cases when the lesion is very small, we realize that we are making errors of that kind. I know a certain percentage is inevitable.

# Upper Gastro-Intestinal Examination After Gastric Surgery[1]

HERBERT R. ZATZKIN, M.D., and AMADEO RIERA, M.D.
Ann Arbor, Mich.

EVERY ROENTGENOLOGIST who is called upon to make upper gastro-intestinal tract examinations upon patients who have been subjected to surgical operations involving the stomach finds it necessary to keep himself informed regarding the current fashions in this field of surgery. He must also be well acquainted with surgical procedures which were in vogue as much as two decades ago, since end-results of operations which are now long out of date are still to be encountered. In either case established roentgenologic landmarks are absent or so altered as to be unrecognizable or misleading.

Those who are currently undergoing training in the specialty of radiology have been assisted in the matter of appreciating the relationship between gastric surgical procedures and the resulting alteration of roentgenologic appearances by the writings of Kirklin (15), Templeton (30, 31), and Hodges (13). In view of the rapid advances which are now being made in the field of abdominal surgery, a review of this particular phase of diagnostic roentgenology appears to be timely.

It is unfortunate that all surgeons do not refer their patients in the early postoperative period for roentgenologic review when major operations involving the stomach have been performed. Too often radiologists have the disadvantage of examining such patients only when untoward symptoms have developed. It is fully as important to be familiar with functionally satisfactory postoperative situations as it is to know the variable limits of normal in persons who have not been subjected to abdominal surgery. The interests of the individual patient are well served if his immediate postoperative status is preserved as a matter of record against the possibility that difficulties may develop at some time in the future.

For practical purposes, established operations involving the stomach fall into six major categories:

1. Simple gastro-enterostomy.
2. Gastric resection plus gastro-enterostomy.
3. Anastomosis between esophagus and stomach or small bowel.
4. Gastro-pancreatico-duodenectomy.
5. Vagotomy.
6. Miscellaneous procedures (pyloroplasty, local excision of ulcer, gastrostomy).

Operations of the first four types are responsible for the greatest difficulties in postoperative roentgen examination, and it is these which will be here considered.

## SIMPLE GASTRO-ENTEROSTOMY

*Posterior gastro-enterostomy* was performed for the first time in 1885 by von Hacker. A loop of jejunum was drawn through a rent in the transverse mesocolon and joined to the stomach by way of a stoma made on the posterior wall close to the greater curvature (Fig. 1, A). The mortality of the operation, as reported by von Hacker, was 70 per cent, a figure which fell to 39 per cent as kinking of the gut and subsequent obstruction were minimized. The posterior type of gastro-enterostomy has entirely replaced the anterior type except in those instances where necessary approaches cannot be made because of extensive disease.

*Anterior gastro-enterostomy* was first performed by Wolfler (19) in 1881. He anastomosed the jejunum, at a point some distance from the ligament of Treitz, to the anterior wall of the stomach above and

[1] From the Department of Roentgenology, University Hospital, Ann Arbor, Mich. Accepted for publication in September 1949.

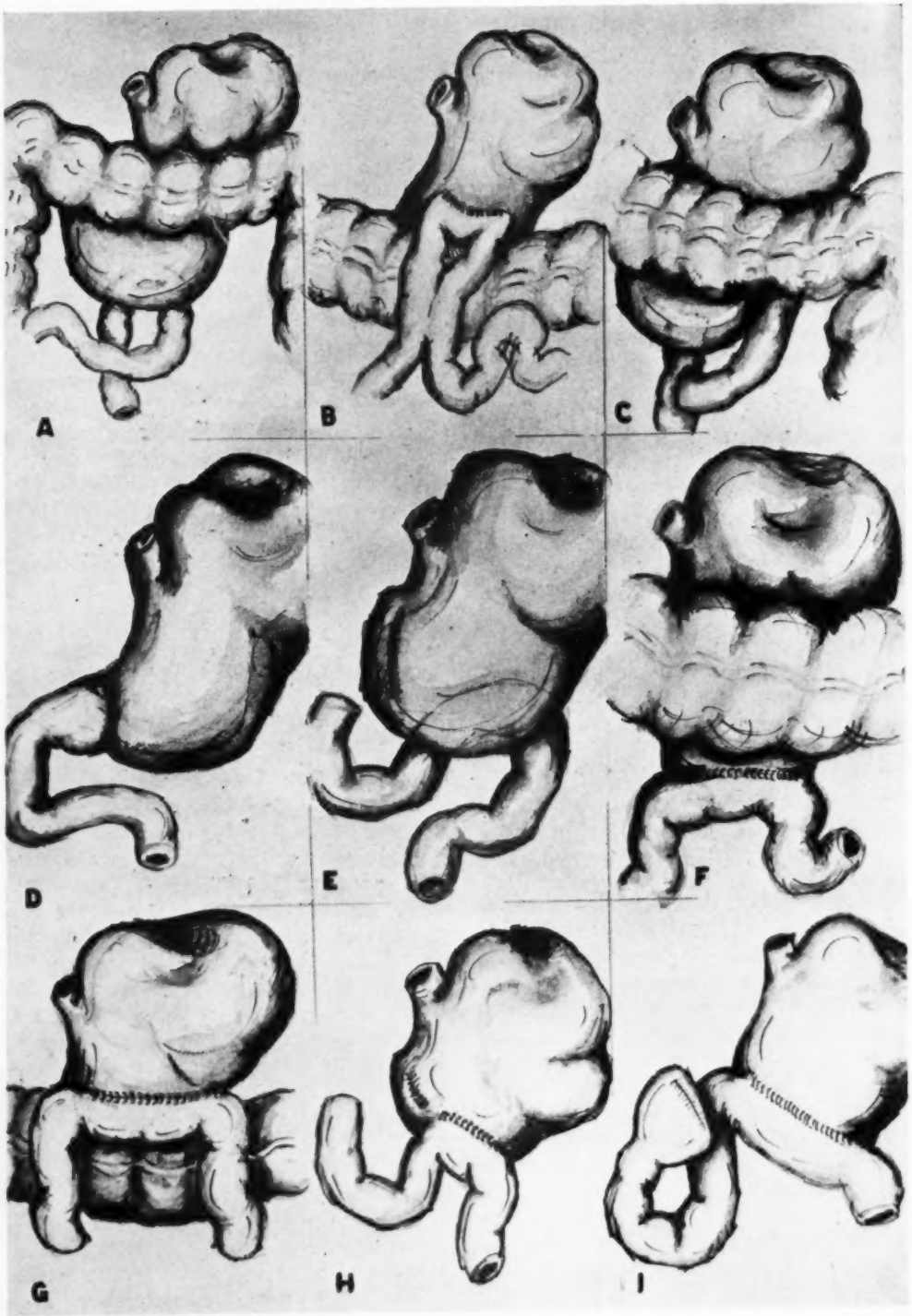


FIGURE 1.

(For legend see opposite page)

anterior to the transverse colon (Fig. 1, B). To this basic procedure, entero-enterostomy was subsequently added to minimize stasis in the loop proximal to the point of anastomosis. The operation as a whole was technically difficult, and the clinical results were far from ideal.

The *en "Y" gastro-enterostomy*, introduced in 1900 by Roux (Fig. 1, C), is a little-used modification of the more common form of posterior gastro-enterostomy. Its purpose is to carry out anastomosis between the jejunum and the stomach in spite of lesions which make inaccessible the portions of the small intestine which are customarily employed. The jejunum is transected some 8 inches below its origin. The distal end is anastomosed to the posterior wall of the stomach and the proximal end is attached, by end-to-side anastomosis, to the gut at the lower point. The "Y" formed by the arms of the jejunum above this second junction gives this procedure its name.

### PARTIAL GASTRIC RESECTION PLUS GASTRO-ENTEROSTOMY

In 1879 Péan resected the pyloric end of the stomach to remove a carcinoma involving that portion of the organ (19). Following this beginning, many surgeons have developed and employed a wide variety of particularized technics for the removal of considerable portions of the stomach and re-establishment of the lumen of the alimentary canal. In 1881, Theodor Billroth of Vienna, the outstanding surgeon of his time, reported his first successful attempt to resect the lower portion of the stomach. The technic which he employed on that occasion still carries his name.

The *Billroth I operation* (Fig. 1, D) consists of resecting the lower portion of the stomach together with a very short cuff of duodenum and performing an end-to-end anastomosis between the duodenum and gastric stump. Modifications of Billroth's original procedure were soon to appear, presented by such men as Finney, von Hacker, and Horsley. Satisfactory materials, instruments, and technics for suturing together the resected portions of stomach and gut were not available and were to come only after long and patient experimenting. Fatal leakage at anastomotic sites occurred often and was greatly feared.

The *Billroth II operation* (Fig. 1, E), a major modification whereby the duodenal and gastric ends after partial resection were tightly closed with multiple rows of sutures, while continuity of the lumen was re-established by means of gastro-enterostomy, was suggested by von Hacker in 1885. This operation was first carried out by Billroth's assistant, von Eiselberg, in the year 1888. Because the procedure requires that a considerable portion of the stomach be left behind if simple gastro-enterostomy is to be feasible, it is not surprising that still further modifications were shortly proposed.

The *Polya operation* (Fig. 1, F) is one modification in which retrocolic end-to-side anastomosis is performed between the open end of the gastric stump and the side wall of the jejunum. This operation has enjoyed a very wide vogue.

The *Balfour operation* (Fig. 1, G) is the Polya procedure performed anterior to the colon, with the use of a loop of jejunum in the isoperistaltic position. Moynihan still further modified the technic by employing an antiperistaltic loop of gut.

The *Hoffmeister modification* of the Polya operation (Fig. 1, H) was developed to minimize the disadvantages of the very large stoma which is characteristic of the original procedure. Too rapid emptying of the stomach is thought to lead to the "dumping syndrome" (3), although this is known to occur in other types of anastomosing operations. Occasionally intussusceptions

Fig. 1. A. Posterior gastro-enterostomy: B. Anterior gastro-enterostomy. C. Roux or *en* "Y" gastro-enterostomy. D. Billroth I simple sleeve resection. E. Billroth II operation, resection with posterior gastro-enterostomy. F. Polya operation, resection with end-to-side gastro-enterostomy. G. Balfour operation, resection as in Polya operation, with anterior anastomosis. H. Hoffmeister operation; only a portion of the greater curvature aspect of the stomach is anastomosed to the jejunum. I. Devine exclusion, gastric division without resection, with Polya type of gastrojejunostomy.

tion or herniation of small bowel into the lumen of the gastric stump may occur following the Polya operation. According to the Hoffmeister technic, the open end of the gastric stump, after resection, is closed with a line of sutures extending from the lesser curvature one-half or two-thirds of the distance to the greater curvature. Anastomosis between stomach and jejunum is performed using only the greater curvature side of the gastric lumen.

The *Devine exclusion operation* (Fig. 1, 1) was designed by Devine of Australia as a method whereby the surgeon could, with considerable rapidity, divide the stomach proximal to a lesion involving its pyloric end and the proximal duodenum and reestablish continuity of the lumen by means of gastro-enterostomy at a distance, using the Polya or Hoffmeister technic. According to the original proposal, it was expected that at a second stage, when the patient's condition might permit, the stomach distal to the line of section, as well as the proximal duodenum, would be dissected free and removed. Since the exclusion procedure was used widely for a time, largely to combat peptic ulcers refractory to medical methods of treatment, one of the hoped-for end-results of partial resection, the abatement of gastric hyperacidity, was not achieved because that portion of the gastric mucosa which produces the activating substance necessary in part at least for acid secretion remained *in situ*. Dissection of the mucosal coat from the pyloric stump, when carried out, is a bloody and difficult step which defeats one of the prime aims of the operation—speed and limited surgical trauma. Persistence or recurrence of ulceration following the operation when only the first stage is carried out has been so worrisome that, following its initial popularity, this operation has fallen into disrepute. Even now, however, patients upon whom it was performed some time ago are encountered upon x-ray examination. Nearly all such patients eventually require more extensive gastric resection and the removal of the pyloric end of the stomach.

In all fairness to this operation, it must be appreciated that excellent results are possible when the surgeon assures the removal of sufficient antral mucosa. Gaviser (10), in his analysis of the results of various surgical procedures in the treatment of peptic ulcers, found that even where the ulcer was left *in situ*, when the surgical excision was adequate, the results were gratifying and a low number of recurrences encountered.

The *sleeve resection*, consisting of removal of a segment of stomach which includes the lesion to be eradicated and re-anastomosis of the open ends of the parts left behind, is almost never encountered today. It was abandoned for a variety of reasons, including troublesome hourglass contraction at the junction point.

### ANASTOMOSIS BETWEEN THE ESOPHAGUS AND THE STOMACH OR THE SMALL BOWEL

Prior to the work of Torek in 1915 (29), patients with lesions located high in the esophagus were doomed to succumb to the disease without treatment other than bouginage or x-ray therapy. Torek devised a procedure which left the patient with an esophagostomy and gastrostomy, both highly undesirable from the latter's point of view. If he did not succumb to the surgery or die of metastases, various esophagoplastic procedures were attempted (Fig. 2, A-E). This was the practice until quite recently.

Progress in this field was directed toward perfecting technics of anastomosis between the esophagus and stomach, and it was in 1938 that Phemister and Adams performed the first successful esophagogastrostomy. The technic in vogue today was popularized by Sweet (28) and grew out of experience with the transthoracic approach for lesions low in the esophagus and upper stomach. It was found that by opening the left lower thorax and incising the diaphragm a wide exposure of the entire upper stomach and lower esophagus was afforded. The transthoracic approach is not a new concept. It was originated by Biondi, an Italian surgeon, in 1895. The technic for mid and

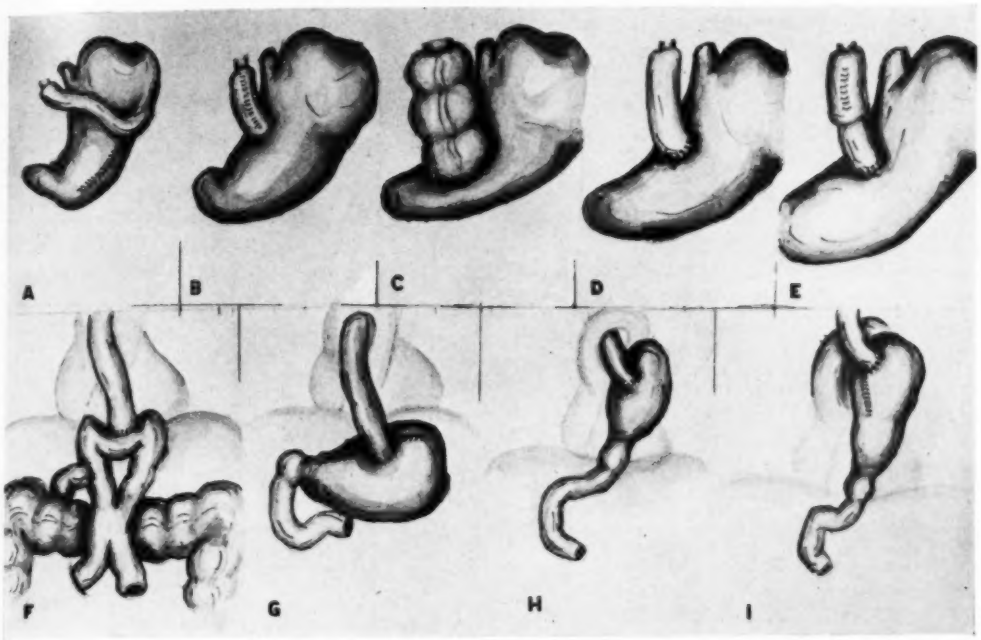


Fig. 2. Esophagoplastic procedures: A. Stomach tube is fashioned from the greater curvature (Beck Jianu). B. Skin tube is used to establish continuity with esophagus. C. A section of transverse colon provides the link between esophagus and stomach. D. A section of jejunum is fashioned into a tube. E. Skin and jejunum. Procedures performed via the transthoracic approach: F. Total gastrectomy, showing esophagojejunostomy, duodenojejunostomy, and jejunojejunostomy. G. Cardiectomy for lesions involving the upper third of the stomach. H. Partial esophagectomy and gastrectomy with esophagogastrostomy for lesions involving the lower third of the esophagus and upper stomach. I. Same as H, with anastomosis at level of aortic arch performed for lesions of mid and high esophagus.

high esophagogastric anastomosis gradually evolved from procedures successfully carried out on lower esophageal lesions. Experience taught just how much of the gastric blood supply could be sacrificed. Surgeons have cut the left gastric and gastro-epiploic arteries as well as the vasa brevia and brought the fundus so high that anastomosis could be carried out above the level of the aortic arch.

In Figure 2 (F-I) are depicted diagrammatically the various levels at which anastomosis may be performed by the transthoracic route. Total gastrectomy may be carried out in this fashion; the surgeon is not necessarily limited by the diaphragm. This latter procedure is fraught with considerable danger, though recent improvements have appreciably decreased the mortality rate. Relieving jejunal tension by adequate mobilization and drainage of duodenal contents via duodenojejunostomy and jejunojejunostomy prevents reflux into the esophagus. The feeling of fullness after even a small feeding, so often a complaint in these patients, may be relieved by the creation of a surgical pouch at the anastomotic site (8).

### GASTRO-PANCREATICO-DUODENECTOMY

Gastro-pancreatico-duodenectomy is designed for the treatment of carcinoma involving the duodenum, ampulla, or head of the pancreas. Halsted in 1899 reported the first case of successful excision of an ampullary neoplasm by local excision and re-implantation of the pancreatic and common ducts into the defect in the posterior duodenal wall. The operation until recently was not too favorably considered, not so much because of the difficult and tedious surgery it necessitated as for fear of the untoward results and physiologic effects attendant upon the removal of the

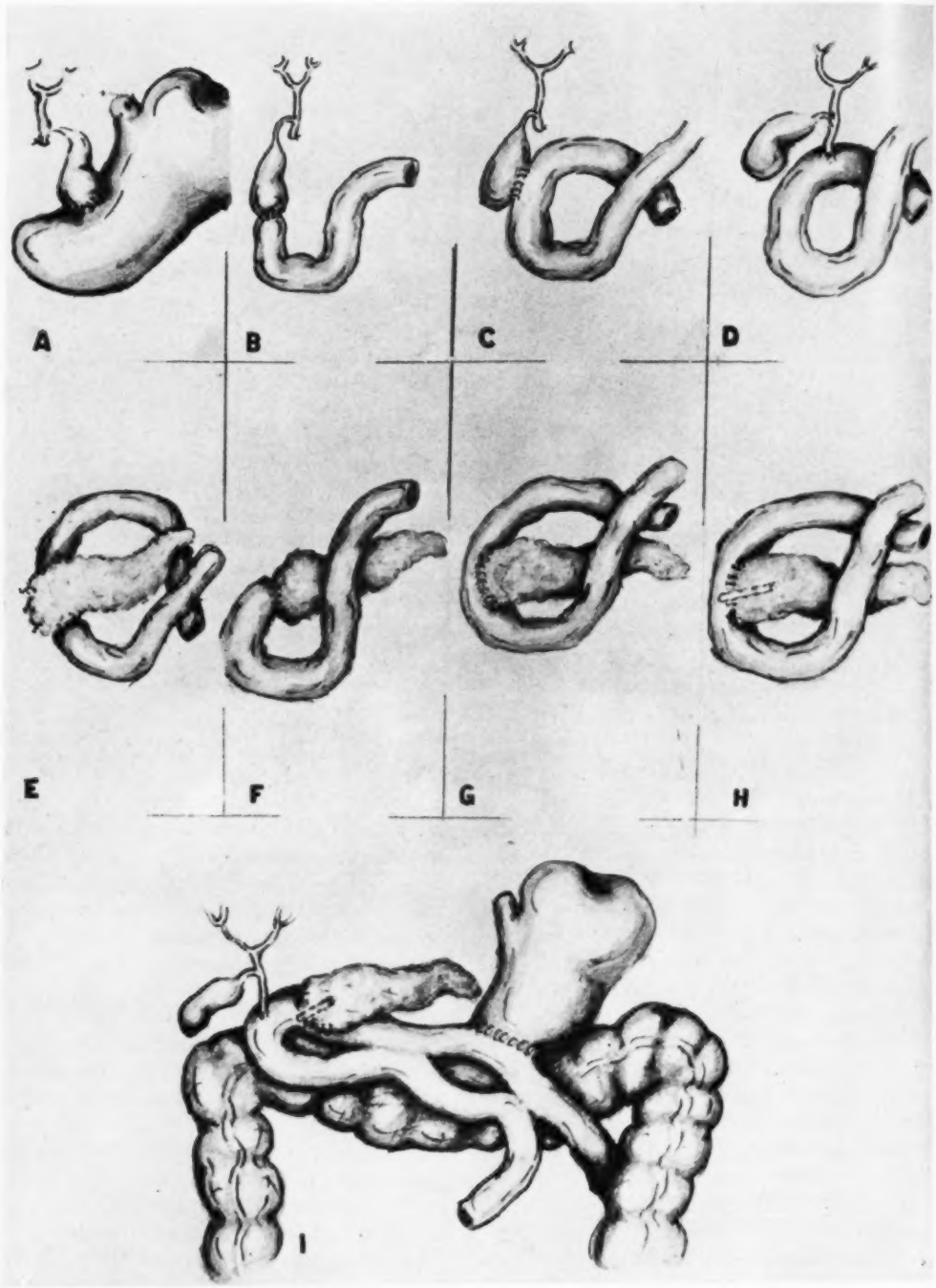


Fig. 3. Biliary tract anastomosis used in gastro-duodeno-pancreatectomy: A. Cholecystogastrostomy (as first used by Whipple, Parsons, and Mullins). B. Cholecystojejunostomy (end-to-end anastomosis). C. Cholecystojejunostomy (end-to-side anastomosis). D. Choledochojejunostomy.

Disposition of pancreas in gastro-duodeno-pancreatectomy: E. Pancreatic stump is tied off. F. Pancreaticojejunostomy (end-to-end). G. Pancreaticojejunostomy (end-to-side). H. Pancreaticojejunostomy (end-to-side, with Robinson catheter draining the pancreatic stump).

pancreatic external secretion from the digestive balance of the body. It was not until Whipple and his associates (34) showed (1935) that the pancreatic duct could be occluded without fatal results that new interest in this operation was aroused. The impulse of this work led to later experimental study indicating the advisability of re-anastomosis of the pancreatic duct to the intestine. Following Whipple's work, there was a steady procession of revisions (4, 5, 6, 7, 20, 21, 22, 23, 35), and every year to the present has seen the introduction of some refinement of the original technic until a sound and thoroughly workable anastomosis has emerged.

The problems confronting early investigators were twofold: first, the prevention of ascending cholangitis; second, the decision as to whether the pancreatic stump should be closed or re-anastomosed. Figure 3 shows the many variations embodied in the technics described in the literature. Each modification bears a man's name, and it is well nigh impossible to recall the contribution of each, noteworthy and outstanding as the work may have been. It has been suggested that all such procedures be referred to as the Whipple operation, and this seems both logical and proper.

Cholecystogastrostomy (Fig. 3, A) was found to predispose to biliary tract infection and was abandoned in favor of end-to-end cholecystojejunostomy (Fig. 3, B). The short loops of jejunum still predisposed to biliary infection and, in addition, the tied end of the common duct would frequently leak. An attempt was made to overcome these faults by a side-to-side anastomosis (Fig. 3, C). Brunschwig (4), in 1944, showed that the choledochojejunostomy (Fig. 3, D), with a long jejunal loop and liberal entero-enterostomy was an answer to this problem.

The pancreas presented a somewhat more difficult obstacle. Steatorrhea and fatty degeneration of the liver frequently resulted upon closure of the pancreatic stump (Fig. 3, E). This led to experimentation with technics for pancreaticojejunal anastomoses. End-to-end anastomosis (Fig. 3, F) was complicated by leakage at the anastomotic site and often led to digestion of nearby structures and even fatal hemorrhage. External pancreatic fistula was also a troublesome complication. In 1946, a technic for successful end-to-side anastomosis (Fig. 3, G), was described (7). The gastric and pancreatic secretions could enter the jejunum distal to the biliary anastomosis. The most recent innovation is the use of the Robinson catheter in the stump of the pancreas with an end-to-side anastomosis (Fig. 3, H). The approach most widely utilized today is indicated in Figure 3, I. This shows a Polya or Hoffmeister gastrojejunostomy and end-to-side pancreaticojejunostomy with use of the Robinson catheter. A choledochojejunostomy and liberal jejunojejunostomy are also provided.

## ANALYSIS OF DATA

During the two-year period, July 1, 1944, to June 30, 1946, 143 persons previously subjected to one or another of these surgical procedures underwent upper gastro-intestinal examination at the University Hospital, Ann Arbor, Mich. Approximately three times each week patients of this type are encountered in the fluoroscopic room. The patients in this group had been operated on at the above institution and elsewhere, chiefly because of intractable duodenal ulcer or gastric carcinoma (Table I).

TABLE I: PRIMARY PATHOLOGY LEADING TO GASTRIC SURGERY IN 143 PATIENTS

| | |
|---|---|
| Duodenal ulcer | 36% |
| Gastric neoplasm | 28% |
| Benign gastric ulcer | 20% |
| Other or unknown | 16% |
| | 100% |

In this series of patients, less than one-fourth were referred for roentgen examination purely for the purpose of recording their postoperative status. All of the others gave a history of annoying or alarming symptoms at varying periods following operation (Table II).

Among the group of patients under con-

TABLE II: REASONS PROMPTING UPPER GASTRO-INTESTINAL EXAMINATION IN THE CASE OF 143 PATIENTS AFTER GASTRIC SURGERY

| | |
|---|---|
| Routine investigation (no postoperative complaint) | 31 |
| Pain | 58 |
| Nausea and vomiting | 28 |
| Jaundice | 7 |
| Hematemesis or melena | 6 |
| Dysphagia | 5 |
| Diarrhea | 3 |
| Weight loss | 3 |
| Other | 2 |
| | 143 |

sideration, a considerable variety of surgical procedures were encountered on upper gastro-intestinal examination. Simple posterior gastro-enterostomy was the most common, approximately one in four. In the case of 13 patients accurate information regarding the nature of the previous surgical procedure could not be determined from the clinical record. In 2 of these it became obvious on x-ray examination that the entire stomach had been removed (Table III).

TABLE III: TYPE OF SURGICAL OPERATION PERFORMED UPON 143 PATIENTS SUBSEQUENTLY EXAMINED

| | |
|---|---|
| Posterior gastro-enterostomy | 38 |
| Anterior gastro-enterostomy | 2 |
| Billroth II | 6 |
| Polya | 4 |
| Balfour, Moynihan | 12 |
| Hoffmeister | 33 |
| Devine exclusion | 3 |
| Cardiectomy | 4 |
| Total gastrectomy | 15 |
| Sweet (high in thorax) | 6 |
| Whipple | 1 |
| Other | 6 |
| No record | 13 |
| | 143 |

Although the examinations here presented were conducted during a two-year period (1944 to 1946), it must be remembered that some of the patients had been operated upon at earlier dates and that many of those operated upon at our hospital during the years covered by this report were not seen in the x-ray department postoperatively. Table III, therefore, does not reflect the true frequency with which the various operations listed are performed. For example, the once popular Devine exclusion procedure, while it is represented by 3 examples, has not been performed in this clinic for several years. Most of the patients included in this report were operated upon at the University Hospital, and the figure of 33 for the Hoffmeister operation indicates the popularity of that procedure among our surgeons.

## ROENTGEN CONSIDERATIONS

The fluoroscopic study of the stomach altered by surgery usually entails a more painstaking and at times a more arduous routine than the usual upper gastro-intestinal examination.

Simple gastro-enterostomy is best examined by starting with a thick paste (rugar). The opaque medium is followed during its descent until its direction of flow, through stoma or pylorus, is determined. If this is not done immediately, the opportunity may be lost as more barium floods the field and the stoma becomes unrecognizable. The stoma may be then occluded by the direct pressure of the examiner's right hand, while with the left hand an attempt is made to milk opaque medium into the distal portion of the stomach. A smouldering lesion in the bulb or evidence of gastritis may be so detected (Fig. 4, B). The thick paste is next manipulated about the stoma, the position of which is determined by rotating the patient. Tenderness is recorded, and ulceration is sought, the possibility being kept in mind that flecks of barium trapped between mucosal folds may create an erroneous impression of an ulcer crater. Simple jejunitis may give rise to tenderness and may manifest itself by coarsening of mucosal folds about the stoma (Fig. 4, C). It should be remembered that the stoma is approximately 1.0 cm. long. In some patients it is rigid and remains open, while in others it possesses a rhythmic activity, in which latter case the stomach is less apt to show inflammatory change (27). When ulceration occurs, it is usually opposite the stoma or within a few inches of it, downstream. The proximal loop may harbor a jejunal ulcer, though this is uncommon. A large jejunal ulcer situated opposite the stoma is seen in Figure 4, D. It is noteworthy that, while the tendency toward jejunal

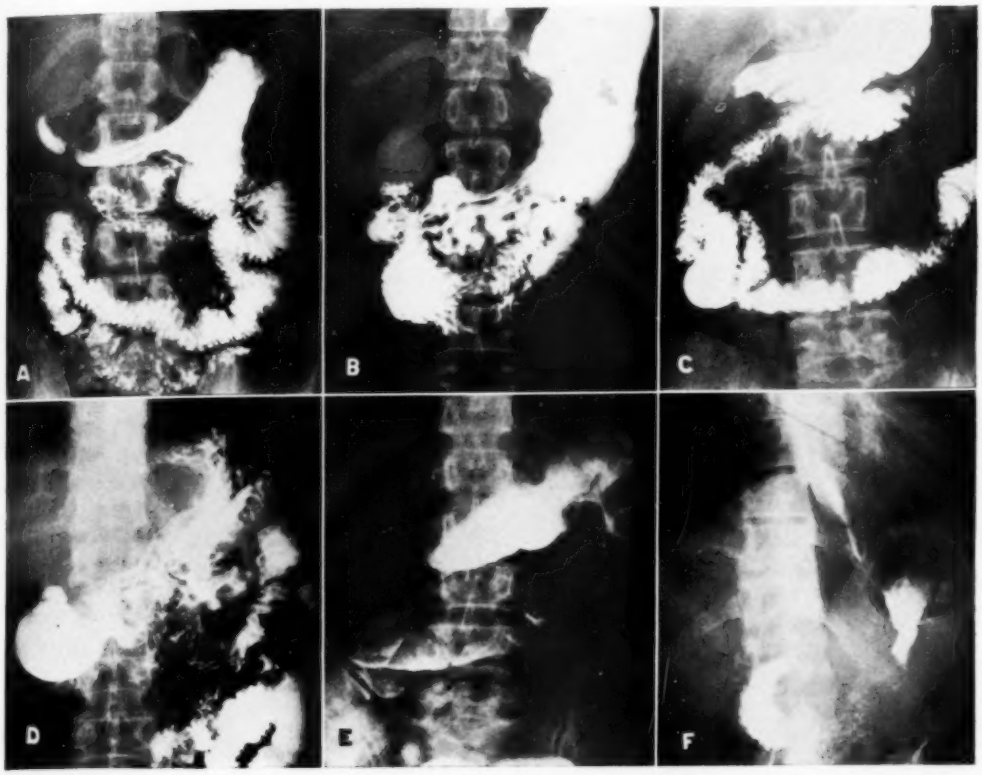


Fig. 4. X-ray findings after gastro-enterostomy: A. Normally functioning stoma; both bowel loops are filled. B. Coarsened rugal folds suggesting gastritis. C. Coarsened jejunal mucosal pattern; jejunitis. D. Ulcer crater directly opposite stoma. E. Gastro-entero-colic fistula detected twenty years after gastro-enterostomy. F. Recurrent gastric neoplasm following partial gastric resection and gastro-enterostomy.

ulceration is encountered in cases treated surgically by posterior gastro-enterostomy for duodenal ulcer, it is a very uncommon occurrence after gastro-enterostomy for gastric ulcer and virtually unheard of following anastomosis with resection for neoplasm (25).

The exact mechanism leading to the formation of recurrent ulcers is not known. The work of Wangensteen and his associates (16, 17, 18, 32) has recently shed much light on this problem. They have demonstrated that performing gastro-jejunostomy with a long afferent loop, such as is necessitated by the anterior gastro-jejunostomy, is to invite the formation of jejunal ulceration. The most plausible explanation appears to be the exclusion of hydrochloric acid, which is the best physiologic stimulus for the secretion of pancreatic juice with high buffer value, from contact with the duodenal mucosa, the segment of mucosa richest in secretin. Another likely cause is the wide spatial separation of alkaline and acid digestive juices. Still another explanation, which has been minimized, is the oft suggested increased susceptibility of successively lower segments of intestinal mucosa. At Wangensteen's clinic the short afferent loop is routinely employed, and in over 300 cases so treated not one recurrent ulcer has developed.

Since approximately 17 per cent of jejunal ulcers go on to gastrocolic fistula formation if untreated surgically, this should be kept in mind as a possible complication. A recent patient seen by the authors, suspected of harboring a gastric neoplasm, was examined because of fecal vomiting. The spectacular appearance

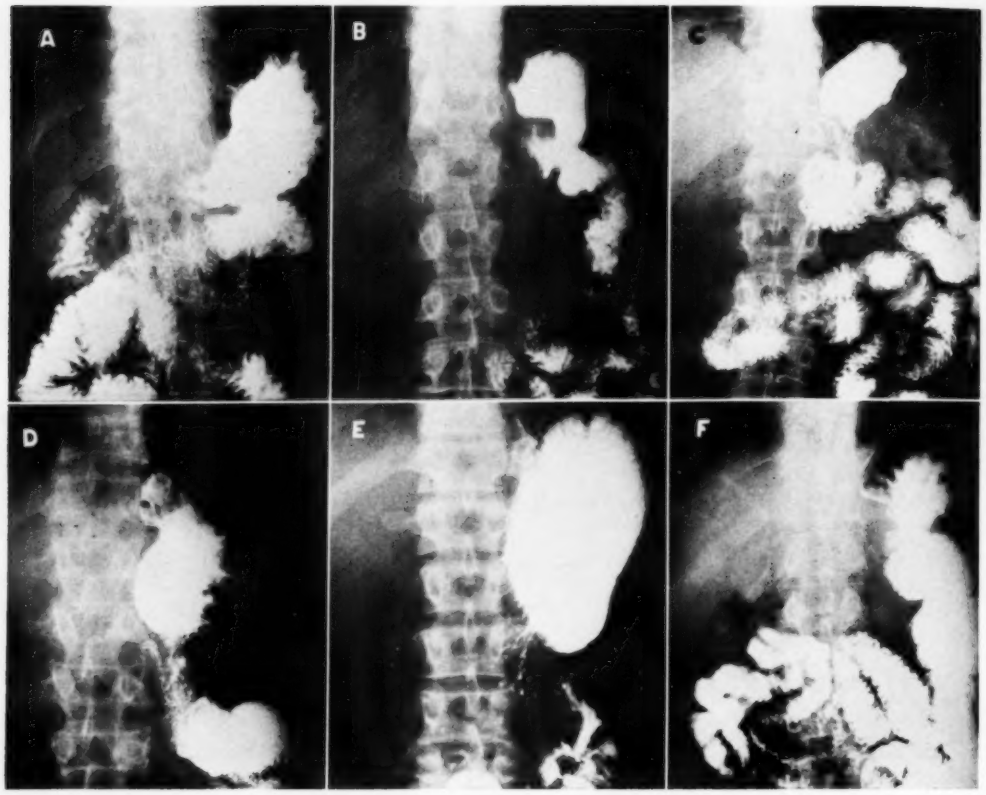


Fig. 5. Characteristic roentgen features following subtotal gastric resection: A. Billroth II; B. Polya; C. Hoffmeister. Examples of subtotal gastric resection without distinguishing roentgen features: D. Billroth II; E. Polya; F. Hoffmeister. (See also Fig. 5, G and H.)

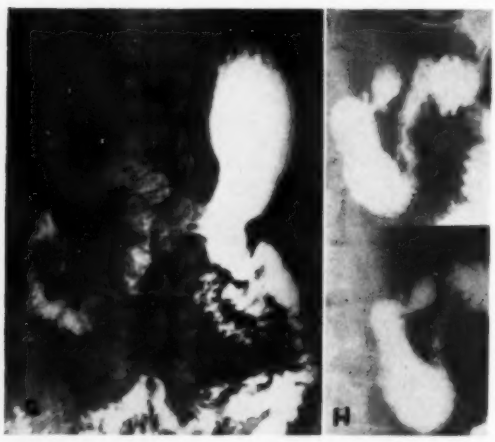


Fig. 5, G and H. Devine exclusion operation: G. de Petz sutures identify the closed lumen of the distal gastric pouch. H. Two exposures showing distal gastric pouch and neighboring duodenal ulcer craters.

of the fistulous tract shown in Figure 4, E is all the more unusual because it was demonstrated by fill from above. Gastrocolic fistulae are usually best shown by the barium enema.

After the mucosa has been thoroughly investigated, the patient is given a tumbler of barium-water suspension to drink. The mixture will be seen to pass at first into the efferent loop and later into the afferent loop. If this does not occur, an attempt should be made to force barium into the proximal loop while the distal segment is occluded by pressure with the examiner's hand outside the beam. The importance of determining the length of the afferent loop has already been emphasized. If loops overlap, the patient can be turned to an oblique position. In

observing peristalsis, it will be noted that barium seldom moves into the afferent loop beyond the ligament of Treitz and, when it does, peristalsis carries it back.

A partially resected stomach is examined in much the same fashion as outlined above, though in addition the fluoroscopist may attempt to identify the type of anastomosis which has been performed. The Hoffmeister, Polya, and Billroth II anastomoses may occasionally present a fairly characteristic roentgen configuration (Fig. 5, A, B, C), though in most instances the various procedures present indistinguishable patterns and are impossible to identify (Fig. 5, D, E, F). When the de Petz sewing machine is used, the position of the row of metallic clips seen on the roentgenogram marks the position of the closed portion of the gastric stump (Fig. 5, G). In examining a case in which the Devine exclusion type of operation has been performed (Fig. 5, G), unless the fluoroscopist is familiar with this procedure, he may fail to demonstrate adequately all the pathologic changes which may be present. An example of a poor result, so frequently encountered with this operation, is shown in Figure 5, H.

The stoma, in a subtotal gastric resection, must be investigated for recurrent neoplasm. The polypoid type of neoplasm has been described as occurring with greater frequency (31), though in the experience of the authors the annular carcinoma, as described by Prevot (24), has been seen more often. Obliteration of the gastric mucosal pattern near the stoma, rigidity of the neighboring stomach wall, and tubular narrowing of the stoma are commonly encountered signs of neoplastic invasion (Fig. 4, F). It is to be remembered that following partial gastric resection for non-neoplastic disease primary carcinoma may be encountered in the gastric stump. Such lesions involve the stoma only by chance.

Obstruction encountered after subtotal gastric resections may be on a basis other than recurrent neoplasm. Wangensteen (33) states that narrowing of the outlet of the distal loop is often the result of the surgeon inverting a greater cuff of tissue than advisable. Considerably more of the readily available jejunum may have been utilized than he intended, with ensuant narrowing of the efferent outlet. In the Hoffmeister plan, this over-suturing does not produce narrowing of the inlet on the afferent side.

A serious complication and one which usually manifests itself early in the postoperative period is occasioned by obstruction of the afferent inlet. Entero-anastomosis may combat this condition, though Wangensteen has abandoned the procedure in favor of a forked in-lying duodenal tube. It is felt that the stoma will function satisfactorily upon withdrawal of the tube seventy-two hours later, when it has been in both the afferent and efferent loops of the anastomosis. This complication of closed-loop duodenal obstruction may well be a cause of death in many patients who succumb from hyperthermia with pneumonia or atelectasis thirty-six to seventy-two hours after gastric resection.

In examining the results of esophagogastrostomy, it must be realized that, as anastomoses are performed at higher levels, the altered physiology incident to section of the vagi must be considered. The supradiaphragmatic stomach may show minimal or no peristaltic activity. The pylorus is frequently in a state of tonus due to the unopposed function of the sympathetic nerve fibers. Figure 6 shows several roentgenograms made following esophagogastric and esophagojejunal anastomoses at various levels. The normal postoperative appearance, though quite bizarre (Fig. 6, B, C), should not be interpreted as representing pathologic change. The supradiaphragmatic pouch is often quite ragged and irregular, and the closed portion of the stomach may lie considerably more to the left than one would expect. This is especially true when the esophageal anastomosis is to the anterior stomach wall and a large pouch which traps and retains alimentary contents for a long period of time may be present (30).

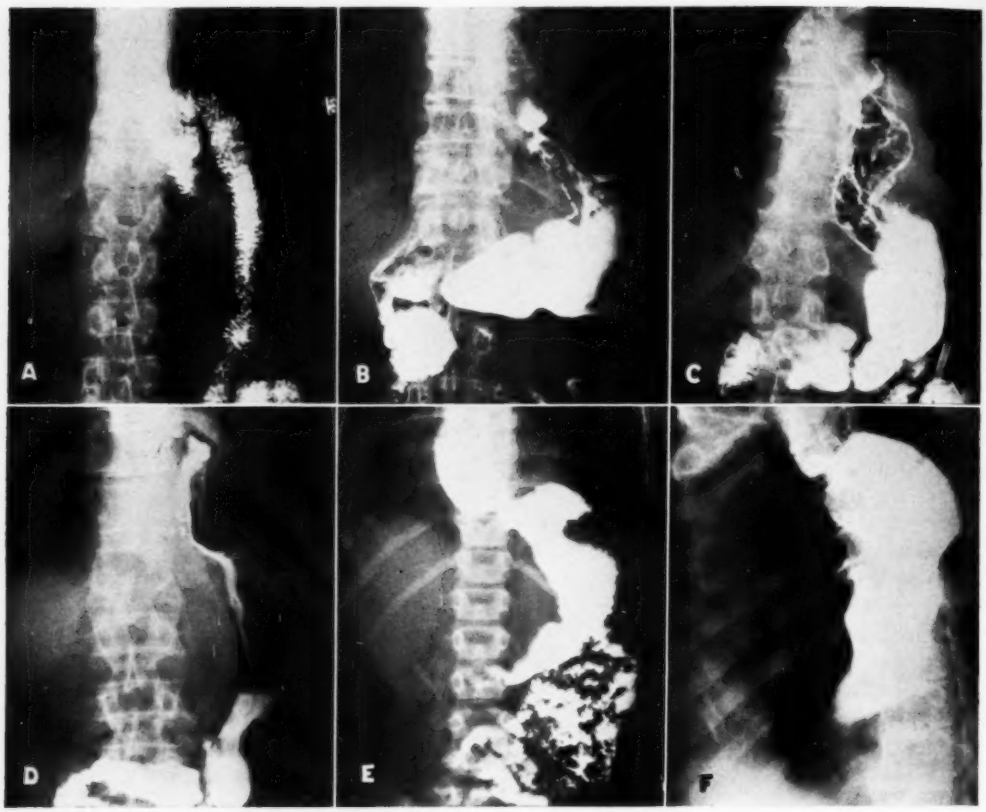


Fig. 6. Roentgen findings following transthoracic procedures: A. Total gastrectomy with esophagojejunostomy. B. Cardiectomy (the de Petz sutures used to close the cardiac end in part produce a bizarre appearance). C. Satisfactory result of partial esophagectomy and cardiectomy with anastomosis above the level of the diaphragm. D. Partial esophagectomy and cardiectomy for carcinoma. Stenosis of the stoma for two months. At autopsy recurrent neoplasm and diaphragmatic herniation of transverse colon were found. E. Partial esophagectomy and gastrectomy for cardiospasm showing supradiaphragmatic pouch. Esophagoscopy showed ulceration near the stoma which cannot be seen here. F. "Sweet" resection with anastomosis at the aortic arch for mid esophageal carcinoma.

The transthoracic approach with high esophagogastric anastomosis is finding application in other than malignant situations. At the University Hospital, long standing cases of lye stricture are being successfully treated in this fashion. More recently a stubborn case of cardiospasm in a nine-year-old boy was so treated. The unusual postoperative roentgen configuration in this case is seen in Figure 6, E. It does not represent an entirely satisfactory result; the patient is still symptomatic, and occult blood is present in the stool. In the past, cardiospasm was treated by dilatation, as suggested by Mickulicz in 1900, or by cardioplasty, as suggested by Wendel in 1910 and Heller in 1914 (11).

Gastro-pancreatico-duodenectomy, when encountered at the fluoroscope, necessitates careful investigation of the multiple anastomotic sites which are present. The fluoroscopist is well advised to discuss the details of the operative procedure with the referring surgeon before undertaking his examination. Without intimate knowledge of this type of operation, it may be virtually impossible to offer an intelligent fluoroscopic evaluation. With diligence, it may be possible to identify the long loop which swings between the gastrojejunostomy and the biliary tract. Air (Fig. 7, A) or barium

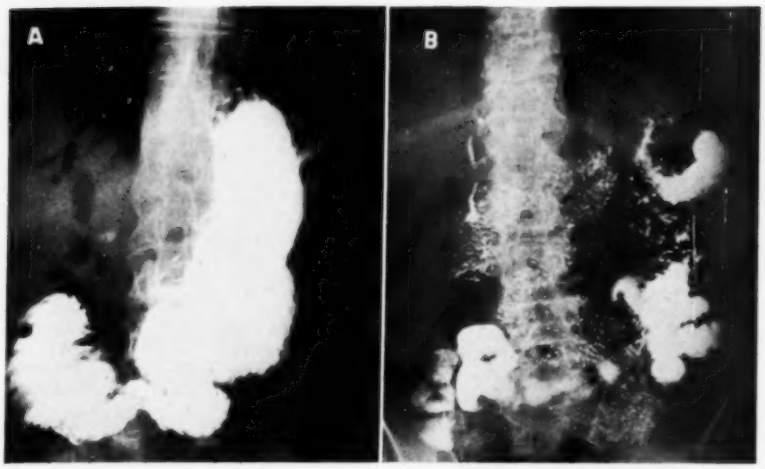


Fig. 7. Roentgenograms of two cases of ampullary carcinoma treated by gastro-duodeno-pancreatectomy: A. The de Petz sutures help to identify the anastomosis as the Billroth II type. Air in the biliary tree marks the site of choledochojejunostomy. B. The long loops of jejunum swinging between the gastro-enterostomy and choledochojejunostomy are well shown. Barium within the common duct marks the anastomotic site.

(Fig. 7, B) within the biliary tree may indicate the point of anastomosis.

## SUMMARY

1. The various types of gastric surgery encountered by the radiologist are reviewed.

2. Clinical data and findings at upper gastro-intestinal examination in 143 patients who had undergone previous gastric surgery are analyzed.

3. The fluoroscopic procedure followed in the Department of Roentgenology, University Hospital, Ann Arbor, Mich., when examining a patient after gastric surgery is described.

4. Familiarity on the part of the fluoroscopist with the various anastomoses which may be encountered is essential for the best performance of this type of examination.

5. It is suggested that all patients who have undergone gastric surgery be subjected to roentgen study of the gastro-intestinal tract in the early postoperative period.

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## REFERENCES

1. ASHLEY, L. B., MILLER, K. T., AND ABBOTT, W. E.: Resection of Duodenum, Common Bile Duct and Head of Pancreas for Carcinoma. Harper Hosp. Bull. **5:** 115–118, August 1947.

2. BELL, H. G.: Treatment of Cardiospasm by Esophagogastrostomy. Surgery **20:** 104–116, July 1946.

3. BERKMAN, J. M., AND HECK, F. J.: Symptoms Following Partial Gastric Resection. Gastroenterology **5:** 85–95, August 1945.

4. BRUNSCHWIG, A.: Surgical Treatment of Carcinoma of the Body of the Pancreas. Ann. Surg. **120:** 406–416, September 1944.

5. CATTELL, R. B.: Pancreatoduodenal Resection: Preliminary Report of 18 Cases. New England J. Med. **232:** 521–526, May 10, 1945.

6. CHILD, C. G., III: Carcinoma of Duodenum. One Stage Radical Pancreaticoduodenectomy, Preserving External Pancreatic Secretion. Case Report. Ann. Surg. **118:** 838–842, November 1943.

7. DENNIS, C., AND VARCO, R. L.: Neoplastic Biliary Obstruction, Improved Type of Radical Pancreaticoduodenectomy for Ampullary and Pancreatic Cancers. Surgery **20:** 72–81, July 1946.

8. ENGEL, G. C.: Creation of a Gastric Pouch Following Total Gastrectomy. Surgery **17:** 512–523, April 1945.

9. EUSTERMAN, G. B., KIRKLIN, B. R., AND MORLOCK, C. G.: The Nonfunctioning Gastroenteric Stoma: Diagnostic Study of 62 Surgically Demonstrated Cases. Am. J. Digest. Dis. **9:** 313–317, October 1942.

10. GAVISER, D.: Clinical Investigation and Evaluation of 416 Cases Consecutively Operated Upon for Peptic Ulcer. Surgery **24:** 873–916, November 1948.

11. GRIMSON, K. S., REEVES, R. J., TRENT, J. C., AND WILSON, A. D.: Treatment of Patients with Achalasia by Esophagogastrostomy. Surgery **20:** 94–103, July 1946.

12. GRÖNINGER, J.: Zur Röntgensymptomatologie

des operierten Magens. Fortschr. a. d. Geb. d. Röntgenstrahlen **44:** 302–319, September 1931.

13. HODGES, F. J.: The Gastro-Intestinal Tract. Chicago, Ill., The Year Book Publishers, 1944.

14. HORSLEY, J. S., BIGGER, I. A., AND OTHERS: Operative Surgery. St. Louis, C. V. Mosby Co., 4th ed., 1937, Vol. 2.

15. KIRKLIN, B. R.: Roentgenologic Determination of Normal and Abnormal Results Following Operations on the Stomach and Duodenum. Am. J. Roentgenol. **33:** 468–478, April 1935.

16. KOLOUCH, F., JR., AND OTHERS: III. Mechanism of Stomal Ulcer Is Related to Length of Afferent Duodenojejunal Loop. Proc. Soc. Exper. Biol. & Med. **58:** 275–280, April 1945.

17. MERENDINO, K. A., AND OTHERS: I. Stomal Ulcer Attending Complete Intragastric Regurgitation Influenced by Length of Afferent Duodenojejunal Loop. Proc. Soc. Exper. Biol. & Med. **58:** 222–225, March 1945.

18. MERENDINO, K. A., AND OTHERS: II. Length of Afferent Duodenojejunal Loop in Gastric Resection, a Factor in Stomal Ulcer. Proc. Soc. Exper. Biol. & Med. **58:** 226–230, March 1945.

19. ORR, T. G.: Operations of General Surgery. Philadelphia, W. B. Saunders Co., 1945.

20. ORR, T. G.: Resection of Duodenum and Head of Pancreas for Carcinoma of the Ampulla. Surg., Gynec. & Obst. **73:** 240–243, August 1941.

21. ORR, T. G., AND WALKER, G. A.: Pancreaticoduodenectomy for Primary Carcinoma of the Duodenum. Surg., Gynec. & Obst. **80:** 149–151, February 1945.

22. ORR, T. G.: Pancreaticoduodenectomy for Carcinoma of the Ampulla and Ampullary Region. Surgery **18:** 144–158, August 1945.

23. PEARSE, H. E.: Simplified Anastomosis for Resection of the Duodenum and Head of Pancreas. Surg., Gynec. & Obst. **75:** 333–336, September 1942.

24. PREVOT, R.: Ergebnisse neuzeitlicher Röntgenuntersuchungen am operierten Magen. Fortschr. a. d. Geb. d. Röntgenstrahlen **56:** 369–386; 499–520, 1937.

25. RANSOM, H. K.: Gastrojejunocolic Fistula. Surgery **18:** 177–190, August 1945.

26. SANDERS, R. L.: Review of 101 Subtotal Gastrectomies for Benign Ulcer. Surgery **18:** 229–237, August 1945.

27. SCHINDLER, R.: Gastroscopy: The Endoscopic Study of Gastric Pathology. Chicago, Ill., University of Chicago Press, 1937.

28. SWEET, R. H.: Transthoracic Resection of Esophagus and Stomach for Carcinoma. Analysis of Postoperative Complications, Causes of Death, and Late Results of Operation. Ann. Surg. **121:** 272–284, March 1945.

29. SWEET, R. H.: Transthoracic Gastrectomy and Esophagectomy for Carcinoma of Stomach and Esophagus. Clinics **3:** 1288–1315, February 1945.

30. TEMPLETON, F. E.: X-Ray Examination of the Stomach. Chicago, Ill., University of Chicago Press 1944.

31. TEMPLETON, F. E.: The Stomach After Operation: Radiologic Consideration of Types of Operation, Peptic Ulcer, and Neoplasm. Cleveland Clin. Quart. **11:** 27–37, April 1944.

32. WANGENSTEEN, O. H.: Importance of Short Afferent Duodenojejunal Loop in Gastric Resection for Ulcer. Bull. Minnesota M. Found. **4:** 82–85, May 1944.

33. WAGENSTEEN, O. H.: Aseptic Resections in the Gastro-Intestinal Tract with Special Reference to Resection of Stomach and Colon. Surg., Gynec. & Obst. **72:** 257–281, February (no. 2A) 1941.

34. WHIPPLE, A. O., PARSONS, W. B., AND MULLINS, C. R.: Treatment of Carcinoma of the Ampulla of Vater. Ann. Surg. **102:** 763–779, October 1935.

35. WHIPPLE, A. O.: Surgical Treatment of Carcinoma of the Ampullary Region and Head of the Pancreas. Am. J. Surg. **40:** 260–263, April 1938.

SUMARIO

**El Examen de la Porción Superior del Aparato Gastrointestinal Después de la Cirugía Gástrica**

Es importante que el radiólogo esté familiarizado con las alteraciones sobrevenidas en el tracto gastrointestinal consecutivamente a los procedimientos quirúrgicos, ya fueran ejecutados recientemente o años antes, puesto que en uno u otro caso los puntos roentgenológicos de referencia pueden hallarse ausentes o estar tan modificados que no sean reconocibles.

Los procedimientos quirúrgicos establecidos que crean las principales dificultades en el examen postoperatorio son la gastroenterostomía simple, la gastrectomía unida a la gastroenterostomía, la anastomosis entre el esófago y el estómago o el intestino delgado y la gastropancreaticoduodenectomía.

El estudio aquí descrito comprendió 143 personas sometidas a exámenes de la porción superior del aparato gastrointestinal en alguna ocasión después de una operación, principalmente por úlcera duodenal o carcinoma gástrico. En 31, el examen postoperatorio fué cuestión de rutina. En las demás, fué motivado por síntomas tales como dolor, náuseas, vómitos, e ictericia.

Al bosquejar la técnica del método roentgenoscópico que debe emplearse en dichos casos, señálase que, para un estudio satisfactorio, resulta indispensable que el roentgenoscopista esté familiarizado con las varias anastomosis que pueden existir.

Propónese que todos los enfermos sometidos a cirugía gástrica sean objeto de un estudio roentgenológico del tracto gastrointestinal en los comienzos del período postoperatorio y que los hallazgos sean debidamente protocolizados para uso en caso de que surjan dificultades alguna vez en el futuro.

# Plasma-Cell Tumor of the Stomach

## With Report of a Case[1]

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PLASMA-CELL tumors of the stomach are of extremely rare occurrence. As recently as 1943, Hellwig (1) reviewed the literature of the preceding thirty-seven years and found only 127 cases of extramedullary plasmacytoma; of these, 5 involved the gastro-intestinal tract and in only 1 (2) were lesions present in the stomach. Since Hellwig's (1) review, we have found reported 2 cases of plasma-cell tumor of the stomach, and recently we encountered a case of our own.

Vasiliu and Popa's case (2), cited by Hellwig, occurred in a female, aged 32, who had a five-year history of dyspepsia and anorexia with abdominal discomfort following meals. X-ray examination revealed stasis of barium at the pylorus. At autopsy a tumor was found involving the stomach, intestine, and lymph nodes locally and in the mediastinum. No mention was made of bone marrow involvement. Due to the widespread lesions, the location of the primary tumor in the stomach has to be considered only as a possibility.

The two more recent cases were definitely described as being primary in the stomach. The first was published by Couret (3) in 1946. The patient was a 48-year-old white female complaining of epigastric pain, distention, and "gas" for approximately eight years. A gastric analysis was reported as "unsatisfactory." X-ray studies revealed a persistent filling defect in the prepyloric region of the stomach. A subtotal gastrectomy with removal of the pylorus was performed. No report is made concerning the urinary Bence-Jones protein, total blood protein, and albumin-globulin ratio; nor is there any mention of bone marrow studies. At first a diagnosis of an inflammatory lesion was made. Following re-exploration, the diagnosis of lymphosarcoma was proposed. The patient expired nineteen days after the second laparotomy. At autopsy the lesion was found to involve the stomach, gastric attachment of the greater omentum and the retroperitoneal spaces, and the diagnosis of plasma-cell tumor of the stomach was established. There was no history of radiation therapy.

Schwander *et al.* (4) reported a case in a 42-year-old colored male. The patient had a history of abdominal discomfort for seven years, with episodes of vomiting. On admission, complete pyloric obstruction was demonstrated roentgenologically. X-ray examination revealed no abnormalities of the long bones. Gastric analysis was negative for free hydrochloric acid. A subtotal gastrectomy was carried out, with removal of an annular mass in the prepyloric region. The patient died fourteen days postoperatively from a pulmonary embolus. The diagnosis of plasmacytoma of the stomach with involvement of the regional lymph nodes was made. There was no report as to the total blood protein, albumin-globulin ratio, urinary Bence-Jones protein, or bone marrow studies.

### CASE REPORT

Our patient was a 63-year-old Negro male, who was admitted Oct. 20, 1948, complaining of pain in the

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Fig. 1. Postero-anterior view of upper gastrointestinal tract showing defect along the greater curvature with lucent polypoid mucosa seen in cardia. The proximal jejunum is depressed by the mass in the stomach.

Fig. 2. Left anterior oblique view showing the masses along the posterior wall, with a small defect along the anterior wall.

upper abdomen and hypertension. The pain was located in the epigastrium, did not radiate, and had been present for three years. At first it had been intermittent, but for five months prior to admission it had been constant and of increasing severity, with occasional relief following ingestion of milk or alkalies. At times it was accompanied by eructation and nausea, but never by vomiting. There had been a 15-pound weight loss during the three weeks prior to admission. Two weeks before entrance to the hospital, the patient suffered an attack of diarrhea, which was not associated with melena. The past history revealed that he had had hypertension for two years, associated with headaches and dizziness.

The patient was well developed, well nourished, alert and co-operative, and in no acute distress. His weight was 150 lb. The heart and lungs presented no abnormalities. The blood pressure was 210/120. No abdominal tenderness or rigidity was noted. The liver and spleen did not appear to be enlarged. In the epigastrium, slightly above and to the left of the mid-line, was a palpable, round, nontender mass, 3 inches in diameter. The mass was freely movable and did not appear to be fixed to neighboring structures. None of the superficial lymph nodes revealed enlargement. The red blood count on admission was 3,850,000 per cu. mm.; white cells numbered 9,900 per cu. mm., with a normal differential count. No abnormal cells were present in the peripheral blood. The serology was negative and the urine was normal. The blood nonprotein nitrogen was 58 mg. per cent. Due to the patient's inability to retain a tube, gastric analysis was unsatisfactory. Serum protein was 5.1 gm. per 100 c.c. with 2.8 gm. albumin and 2.3 gm. globulin. Urinary Bence-Jones protein was absent. A chest roentgenogram on admission was negative.

X-ray examination revealed the presence of a smooth filling defect along the greater curvature of the stomach involving a 7-cm. segment extending to a point 5 cm. from the pyloro-duodenal junction (Fig. 1). Adjacent to this and along the posterior wall of the greater curvature was another rounded filling defect approximately 3.5 cm. wide (Fig. 2). The masses in the stomach were inseparable from the palpable mass in the epigastrium. The first 15 cm. of the jejunum showed evidence of smooth extrinsic pressure due to displacement by the tumor described above. The duodenal bulb and loop revealed no evidence of disease. There was no five-hour retention of barium in the stomach. A barium enema study disclosed no evidence of an intrinsic lesion in the colon. There was noted, however, a smooth extrinsic pressure defect involving a 10-cm. segment of colon adjacent to the mass previously described. Skeletal survey showed no signs of bone involvement.

The patient was operated upon on Oct. 29, 1948, and a large tumor was found located along the

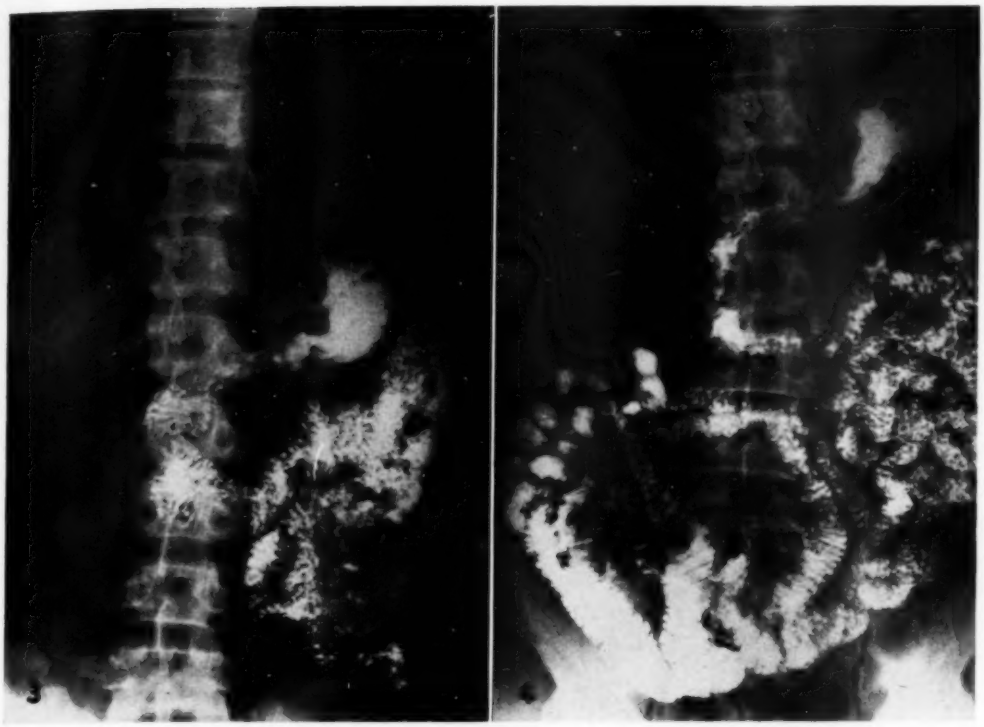

Fig. 3. Postoperative film early in the course of radiation therapy showing the resected stomach directly anastomosed to the duodenum. Note residual tumor along the lesser curvature and return of jejunum to normal position.

Fig. 4. Postoperative film following completion of radiation therapy, showing no evidence of residual tumor.

greater curvature of the stomach in the prepyloric region. There were small, firm, shotty nodules in the gastrocolic ligament. A few large lymph nodes were present adjacent to the tumor. No other evidences of tumor spread were noted grossly. A block excision of the lower three-fourths of the stomach, including the pylorus, the gastrocolic ligament, and the omentum, was carried out. Twenty-three centimeters of transverse colon were resected because of involvement of the middle colic vessels by the tumor. A biopsy specimen taken from the remainder of the stomach along the line of section was later discovered to contain tumor (Fig. 3). The postoperative course was uneventful.

On Nov. 1, the third postoperative day, a course of radiation therapy was begun. The original plan was to deliver 2,100 r to the mid-line in twenty treatment days. The patient, however, tolerated radiation poorly; treatments resulted in severe nausea, vomiting, and a drop in white count to approximately 3,700 cells. For this reason about 80 per cent of the originally planned course of therapy was given. During a thirty-day period, a mid-line dosage of 1,700 r was administered on twenty treatment days. During the hospital course, the red blood count rose from 3.8 to 4.15 million cells per cubic millmeter. A postoperative sternal marrow aspiration did not reveal any plasma cells or abnormal cells. Bence-Jones protein was absent from the urine. The weight, which prior to surgery varied from 148 to 150 lb., dropped to 127 lb. and on discharge was 132 lb. Following treatment the patient's condition appeared good and gastro-intestinal studies revealed no residual tumor (Fig. 4). He was discharged Dec. 16, 1948.

The operative specimen consisted of the major portion of the stomach, gastrocolic ligament with attached omentum, a small portion of duodenum and 23 cm. of transverse colon (Fig. 5A). The stomach measured 24 cm. along the greater curvature and 16 cm. along the lesser curvature. On opening it, a large mass and several smaller lesions were found (Fig. 5B). The large mass partially filled the lumen of the stomach and was located predominantly along the greater curvature, the distal border of which was approximately 4 cm. proximal to the pylorus. Although the exact borders of the lesions could not be determined, the largest mass measured approximately 10 × 8 × 7 cm. and the smaller lesions varied from 2 to 4 cm. in diameter.

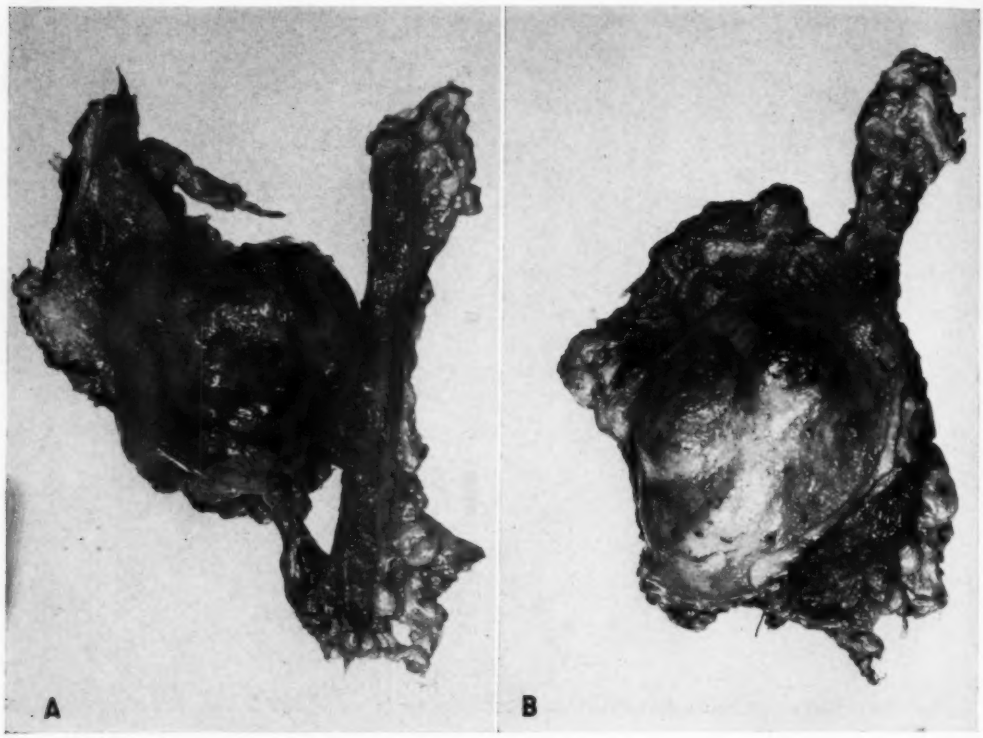


Fig. 5. Operative specimen. A. Showing the mass in the stomach and attached segment of colon. B. Stomach opened along the lesser curvature, showing tumor masses.

The masses were covered by a thin-stretched mucous membrane with occasional submucosal hemorrhages. The gastrocolic ligament was slightly indurated and appeared grossly invaded. The inferior gastric lymph nodes were somewhat prominent. The greater omentum and transverse colon appeared grossly normal. Sections of the masses revealed a moderately firm, white, homogenous glistening surface. Here and there areas of necrosis and hemorrhage were noted.

The tumor, although located in the fundus and antrum of the stomach, did not appear to involve the pyloric sphincter or duodenum. Multiple sections from the tumor in the stomach revealed masses of plasma cells having single and multiple nuclei (Fig. 6). Most of the chromatin was condensed at the periphery of the nuclei. Many of these nuclei were eccentrically placed, and a large amount of cytoplasm took a bright pink color when stained with eosin-hemotoxylin. Many cells contained multiple nuclei, varying in number from two to four. All sections revealed solid masses of plasma cells and therefore did not suggest a granulomatous lesion. The tumor involved the entire wall of the stomach, extending to the serosa. The borders of the masses were not sharply delineated from the normal gastric wall (Fig. 7).

There was infiltration of plasma cells in the gastrocolic ligament (Fig. 8), as well as metastases to the inferior gastric lymph nodes (Fig. 9). Neither the colon, pyloric sphincter, nor the duodenum revealed any evidence of tumor invasion.

The Army Institute of Pathology (5) and Dr. Arthur Purdy Stout (6) reviewed the slides and concurred in the diagnosis of primary plasmacytoma of the stomach.

The patient was studied on follow-up admissions at three-month and seven-month intervals. On both succeeding admissions urinary Bence-Jones protein was absent. An iliac marrow aspiration performed three months postoperatively proved unsatisfactory. Follow-up bone marrow studies were repeatedly requested, but the patient refused to grant permission. Serum protein on the first follow-up examination was 7 gm. per 100 c.c., with 3.3 gm. albumin and 3.7 gm. globulin. A repeat determination, done on the last admission, showed 6.5 gm. of protein per 100 c.c., with albumin 3.5 gm. and globulin 3 gm. Extensive skeletal surveys and gastro-intestinal x-ray studies done three and seven months postoperatively disclosed no evidence of tumor recurrence or spread. Seven months following surgery, the patient had gained approximately 20 lb. and had no return of symptoms.

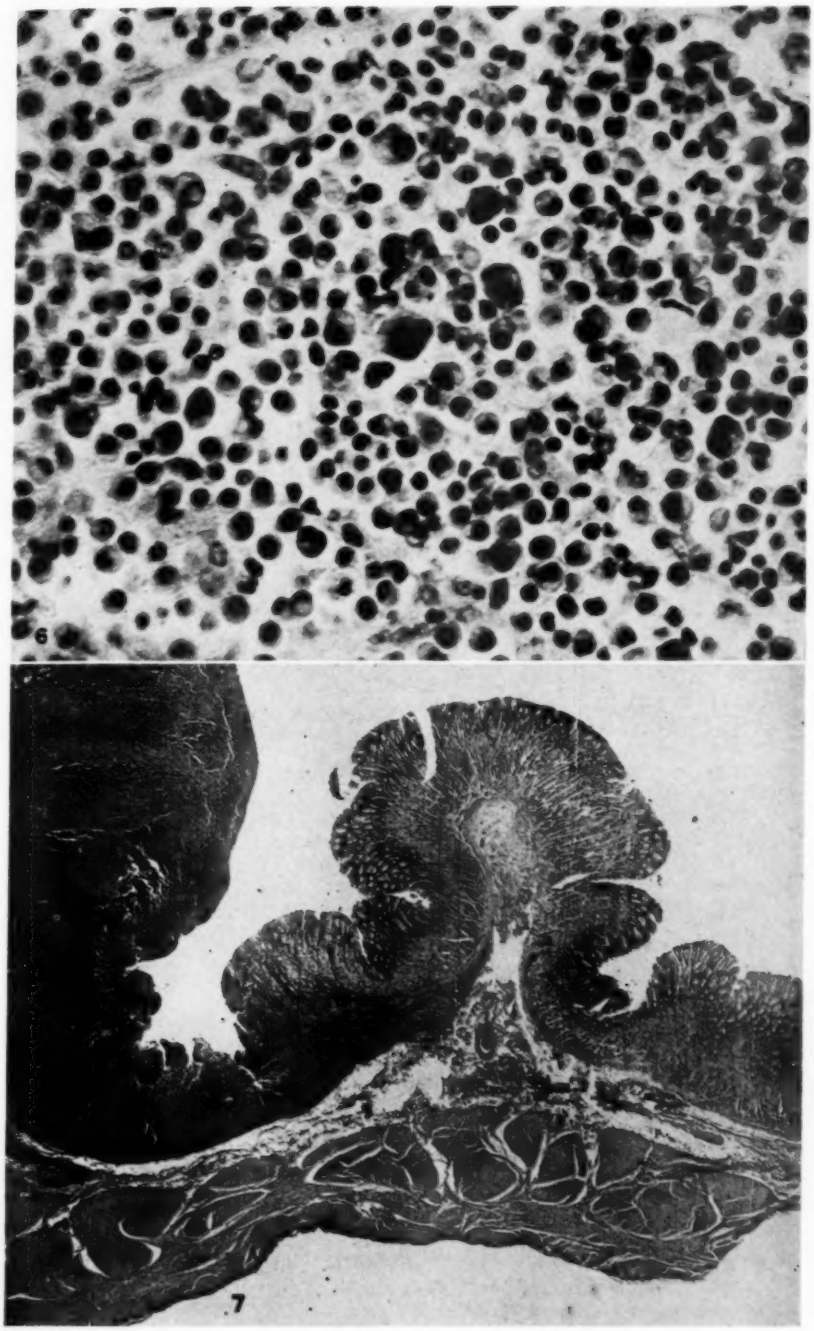

Fig. 6. High-power magnification of representative area of tumor showing both mononuclear and multinucleated plasma cells.

Fig. 7. Low-power magnification of stomach showing junction of tumor and normal mucosa.

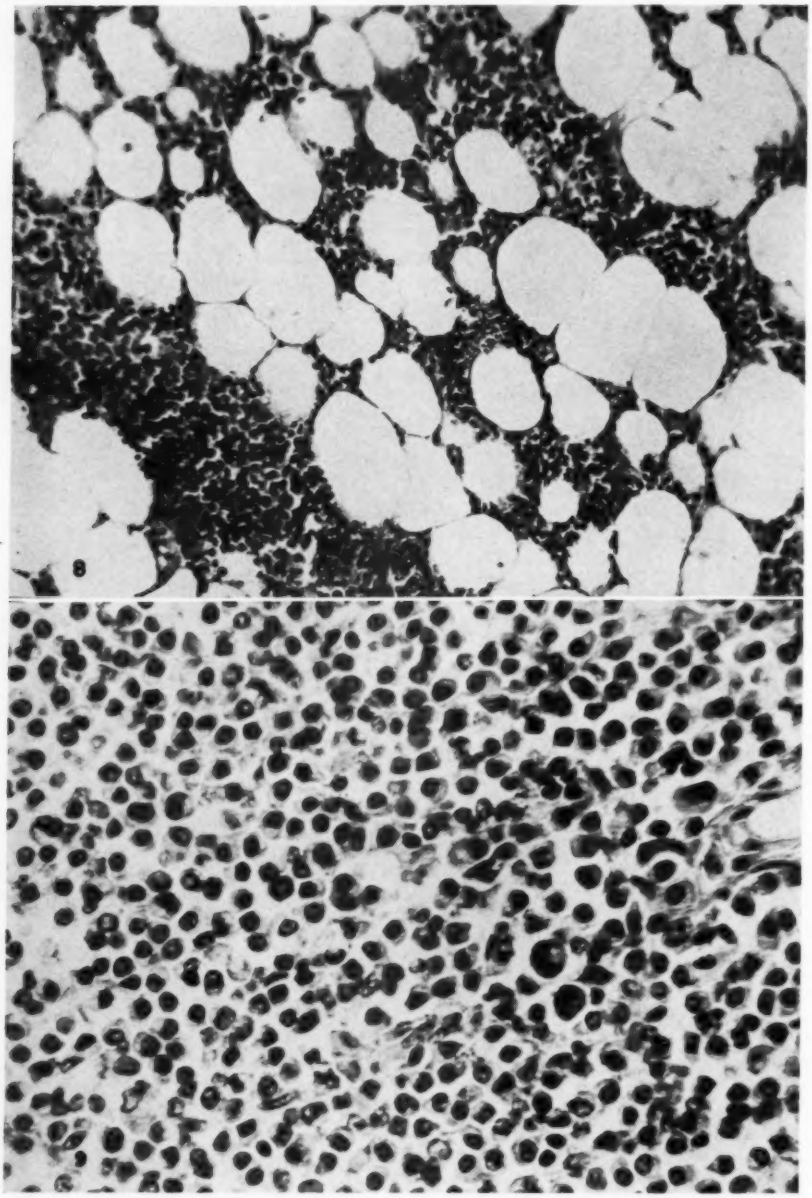

Fig. 8. Photomicrograph of gastrocolic ligament showing infiltration by plasma cells.
Fig. 9. High-power magnification of lymph node showing infiltration of mononuclear and multinucleated plasma cells.

## COMMENT

The case presented here plus the two previously reported by Couret and Schwander *et al.* makes a total of 3 cases of known primary plasma-cell tumor of the stomach. Two were in males and one in a female. The ages varied from 42 to 63. There was no evidence of bone involvement

in the case presented here, and no bone lesions were found in the two other cases at autopsy. Subtotal gastrectomy was the method of therapy in two patients, and in the third instance a combination of subtotal gastrectomy and radiation therapy was employed. Of the two patients treated by surgery alone, one expired following resection, and the other died fourteen days postoperatively from a pulmonary embolus. In the case presented in this paper a combination of gastric resection and radiation therapy was used. The patient has been living eight months postoperatively and at the last follow-up examination showed no evidence of metastasis. It is impossible to draw any conclusion from so few cases; but since some extramedullary plasma-cell tumors have a benign course, it is of interest to note that all three patients gave a long history of abdominal discomfort. In one case autopsy revealed cholecystitis, which could have explained the symptoms. Incomplete information makes it impossible to establish any correlation as to bone marrow findings, urinary Bence-Jones protein, total blood proteins, or albumin-globulin ratio. In our case, even after follow-up of eight months, these findings were not abnormal.

SUMMARY

A brief review of the literature and a report of one additional case of plasma-cell tumor of the stomach has been presented. The addition of this case makes a total of three such tumors in the literature. In the case reported there was no evidence of bone lesions or other laboratory findings associated with multiple myeloma at the end of eight months follow-up. The patient was treated by subtotal resection of the stomach and radiation therapy and at present shows no evidence of tumor.

ACKNOWLEDGMENT: We are indebted to Dr. Philip Pizzolato for the blood studies in this case.

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REFERENCES

1. HELLWIG, C. A.: Extramedullary Plasma Cell Tumors as Observed in Various Locations. Arch. Path. **36:** 95–111, July 1943.
2. VASILIU, T., AND POPA, R.: Forme gastro-intestinale des tumeurs dites plasmocytomes. Compt. rend. Soc. de biol. **98:** 646–648, March 9, 1928.
3. COURET, J. S.: Extramedullary Plasma Cell Tumor of the Stomach. A Case Report. Am. J. Clin. Path. **16:** 213–218, March 1946.
4. SCHWANDER, H., ESTES, J., AND COOPER W. G.: Plasmacytoma of the Stomach. Report of Case. Am. J. Path. **23:** 237–243, March 1947.
5. ARMY INSTITUTE OF PATHOLOGY: Personal communication.
6. STOUT, A. P.: Personal communication.

SUMARIO

**Tumor Plasmocelular del Estómago, con Presentación de un Caso**

El caso comunicado, unido a dos que aparecen en la literatura forma un total de 3 casos conocidos de tumor plasmocelular primario del estómago. Dos fueron en varones y uno en mujer. La edad de los enfermos varió de 42 a 63 años. En el caso descrito ahora, no había signos de invasión ósea, y en los otros dos no se descubrieron en la autopsia lesiones óseas. En los dos casos anteriores, la gastrectomía subtotal constituyó el método terapéutico. En el caso de los AA., se combinó la misma con la irradiación. Uno de los dos enfermos tratados solamente con la resección murió inmediatamente después de la operación y el otro a los catorce días de la intervención, de una embolia pulmonar. El paciente de los AA. se halla vivo y sin signos de tumor a los ocho meses de la operación. En la última observación, a los siete meses, no había indicios de lesión ósea ni otros hallazgos que indicaran mieloma múltiple.

# Cardio-Esophageal Relaxation[1]

## Report of Three Cases

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IN 1947, NEUHAUSER and Berenberg (1) described the syndrome of cardio-esophageal relaxation as a cause of infantile vomiting. In the past six months, two similar cases have been seen at this hospital, and another discovered in a review of our files. In this report an additional roentgen feature and a treatment experiment are described, but the main purpose is to add these cases to the literature and to emphasize the ease with which some instances of vomiting in infancy can be diagnosed and successfully treated.

### CASE REPORTS

CASE I: M. B., a 17-day-old male, admitted with a history of vomiting after feedings since birth, presented no abnormal physical findings except those of undernourishment. Fluoroscopy and films revealed esophageal dilatation (Fig. 1) and retrograde flow from the stomach into the esophagus with respirations and with external pressure to the abdomen. A diagnosis of cardio-esophageal relaxation was made and postural treatment was instituted with excellent results.

CASE II: A. R., a 5-day-old male who had been vomiting all feedings since birth, was undernourished but showed no other abnormal physical signs. The admission diagnosis was esophageal atresia. Scout films gave evidence of a pneumonic process in the right upper lobe (Fig. 2). There was a moderate amount of gas in the stomach but little in the intestinal tract. Although the stomach was not dilated, it was thought that a duodenal atresia might be present. Lipiodol passed readily down the esophagus and into the stomach. The esophagus was dilated and there was a ready reflux of oil from the stomach to the esophagus. This was demonstrated several times. The remainder of the gastro-intestinal tract, as viewed in subsequent films, appeared normal.

After a week of successful postural treatment, a second examination was performed (Fig. 3). There persisted a marked degree of cardio-esophageal relaxation. The patient was then given atropine, gr. 1/4000, subcutaneously, after which a second examination was made. The cardiac sphincter was prominently demonstrated (Fig. 4). Since the patient had been improving on postural treatment alone, atropine was not used therapeutically, and progress continued satisfactorily.

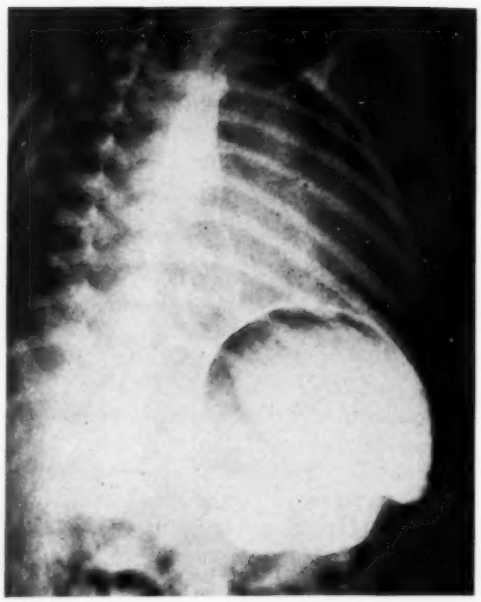

Fig. 1. Case I: Dilated esophagus with relaxed hiatus.

CASE III. J. A. E. (case found in review of files), a 15-day-old female, admitted with a diagnosis of pyloric stenosis, had a history of persistent vomiting after meals and failure to gain. Roentgen examination revealed a dilated esophagus (Fig. 5) and free flow of barium from the stomach into the esophagus upon abdominal palpation. No evidence of pyloric stenosis was demonstrated. The patient was thought to have an intermittent pyloric spasm, the significance of the radiographic findings not being appreciated at that time. It is of interest that this patient was treated with atropine for pyloric spasm and became asymptomatic in about two weeks.

### DISCUSSION

The radiographic studies of these patients are in complete agreement with

[1] From the Department of Roentgenology of the Denver Children's Hospital. Accepted for publication in September 1949.

those described by Neuhauser and Berenberg, including the fluoroscopic evidence of non-function of the cardio-esophageal sphincter, dilated esophagus, and lack of the usual diaphragm and stomach contracture in vomiting. Lack of the usual amount of intestinal gas has been noted as an additional finding in one of our cases. It led to the suspicion of a duodenal obstruction, and the true nature of the disorder was discovered only at fluoroscopy. It is suggested that the defective cardio-esophageal mechanism may permit free passage of gas upward but allow little or none to be forced through the pylorus. This sign is not presented as a necessary adjunct to the positive criteria enumerated in the original description, but more to point out that cardio-esophageal relaxation must be considered in the differential diagnosis when the scout film of the infantile abdomen shows the intestines to be devoid of gas.

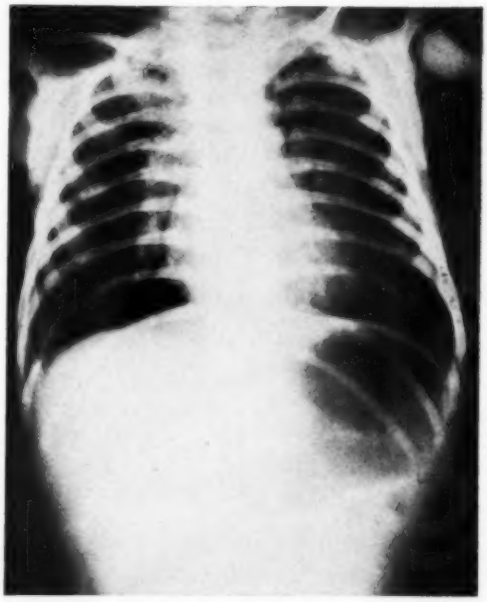

Fig. 2. Case II: Scout film showing aspiration pneumonia, on right, and lack of gas in intestines.

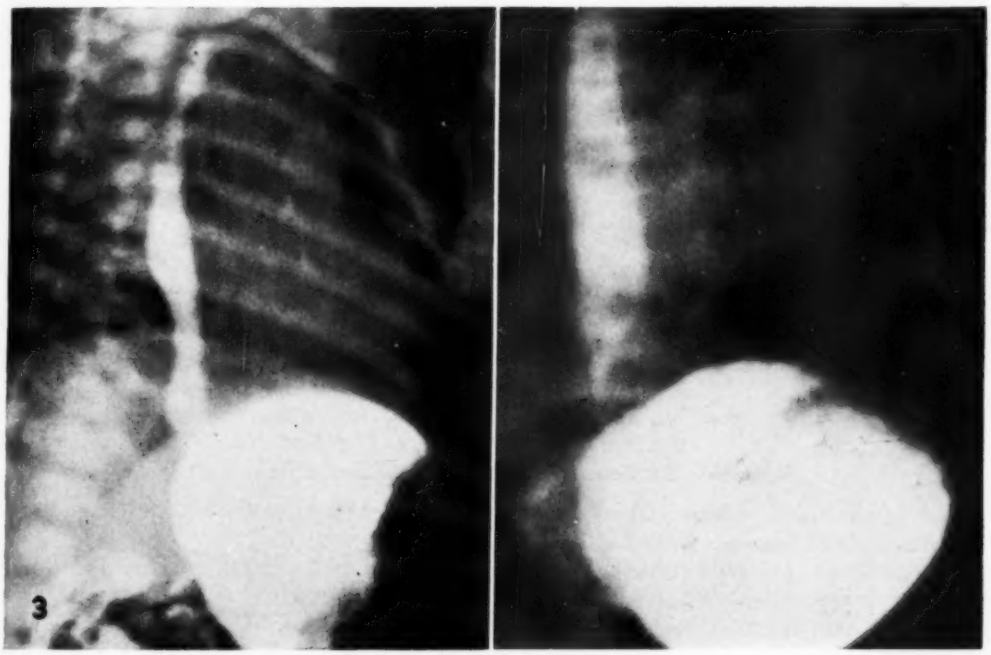


Fig. 3. Case II: Film obtained after one week of postural treatment, showing reflux into esophagus through relaxed cardio-esophageal opening.

Fig. 4. Case II: Film obtained on same day as that in Figure 3, this examination being preceded by atropinization. Cardio-esophageal region now contracted. No reflux could be demonstrated.

Fig. 5. Case III: Probable cardio-esophageal relaxation. Case unrecognized at the time. Film shows dilatation and relaxation of cardia.

Treatment by keeping the infant in a semi-upright position, as suggested by Neuhauser and Berenberg, has been entirely adequate. As a therapeutic experiment, however, a trial of atropinization was made in one case (Case II), with preliminary and follow-up examinations. Since the vagus exerts an inhibitory effect on the sphincteric muscles (2), atropine might be expected to relieve the condition, provided the sympathetic system functions normally. This was found to be the case, the preliminary film (Fig. 3) showing the dilated open cardia, while the post-atropine film (Fig. 4) demonstrates sharp contraction. This experiment substantiates the autonomic imbalance theory suggested by the original authors. Whether atropine may prove of practical value as an adjunct in the therapy of more severe cases may be determined by further trial.

## CONCLUSIONS

1. The discovery of two new cases of infantile vomiting caused by cardio-esophageal relaxation in the past six months suggests that many of the undiagnosed cases of infantile vomiting may, by proper roentgen examination, be so classified and successfully treated.

2. Absence of intestinal gas was observed in one of these cases, a feature not previously described. When gas is absent from the intestine of an infant, cardio-esophageal relaxation must be added to the possibilities.

3. Atropine acted favorably in a single experiment.

NOTE: The author is indebted to Drs. W. W. Barber and E. Friedman, whose patients are presented.

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## REFERENCES

1. NEUHAUSER, E. B. D., AND BERENBERG, W.: Cardio-Esophageal Relaxation as a Cause of Vomiting in Infants. Radiology **48:** 480–483, May 1947.

2. BEST, C. H., AND TAYLOR, N. B.: The Physiological Basis of Medical Practice. Baltimore, Williams & Wilkins Co., 4th ed., 1945.

## SUMARIO

### Dilatación Cardioesofágica. Comunicación de Tres Casos

Los tres casos comunicados son de vómito infantil ocasionado por relajación cardioesofágica: dos descubiertos en un período de seis meses y el otro tomado de los archivos de una institución (el Hospital de Niños, Dénver, Colorado). Indícase aquí que muchos casos de vómito infantil sin diagnóstico etiológico tal vez podrían, mediante un examen roentgenológico adecuado, ser encasillados en este grupo y debidamente tratados.

En uno de los casos, notóse ausencia de gas en el intestino, o sea una característica no descrita antes. Con este hallazgo, hay que tomar en cuenta la dilatación cardioesofágica en el diagnóstico diferencial.

En uno de los casos se probó la atropina con efecto favorable.

# Perforation of Peptic Ulcer[1]

## A Roentgenologic Consideration of the Various Forms and Uncommon Types of Perforation

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PERFORATIONS complicating peptic ulcer are of common occurrence. They may be classified in five groups: (1) into the greater peritoneal cavity, (2) into the lesser peritoneal cavity, (3) retroperitoneal, (4) localized walled-off perforations, and (5) perforations into other organs. The vast majority of recognized perforations are of the diffuse, spreading type, involving the greater peritoneal cavity. A perusal of the literature reveals scant information on the other forms.

Acute diffuse perforations involving the greater peritoneal cavity occur in two forms: a progressive type, requiring immediate surgical intervention, and a *forme fruste* which spontaneously seals itself. In the diffuse progressive form, there is a spreading generalized peritonitis with free air and often fluid in the greater peritoneal cavity. Perforation of this type is an acute abdominal catastrophe, accompanied by shock and prostration. There is usually a history of ulceration of long standing. The clinical and roentgen diagnosis is made with comparative ease.

The *forme fruste* perforation likewise produces an acute abdominal picture. The initial symptoms are similar to those in the progressive diffuse type. There are board-like rigidity of the abdomen and prostration, accompanied by pain, though this is less excruciating than in the classical case. According to Singer and Vaughan (1, 2), the symptoms subside in from two to ten hours, leaving the patient in comparative comfort. The roentgen examination in this form of perforation may or may not reveal evidence of free air in the peritoneal cavity. Demonstration of air depends upon how quickly the perforation becomes sealed and the amount of air escaping.

The lesser peritoneal cavity perforations have not been given much consideration and are not mentioned in most textbooks. In a perusal of the available literature, only one report on this subject (3) could be found. The reason for this paucity of reports is not that perforation into the lesser peritoneal cavity never occurs, but perhaps rather that it has not been recognized. This condition will be described in detail in a forthcoming paper (4).

Retroperitoneal perforation complicating peptic ulcer is comparatively rare. When the ulcer is situated on the posterior wall of the distal two-thirds of the duodenum, it may perforate into the retroperitoneal cavity, since this portion of the duodenum is located retroperitoneally. The anterior wall of the distal duodenum faces the greater peritoneum; the posterior wall faces the retroperitoneal cavity. In this type of perforation there is usually an acute onset of symptoms, with severe pain in the back. Roentgen examination does not show the usual characteristic signs of perforation. A flat film of the abdomen, made in the supine position, will reveal evidence of air in the retroperitoneal spaces, surrounding the kidneys, along the cecocolon and right psoas muscle. The air tends to rise beneath the left diaphragm and up into the mediastinum.

Localized walled-off perforations are not uncommon complications of peptic ulcer. They may be classified as follows:

(1) Non-sealed chronic perforation into a walled-off pocket, which fills with barium.
   (*a*) Forming part of the ulcer crater and presenting an accessory pocket or pseudo-diverticulum.
   (*b*) With a pocket at a distance from the ulcer crater.

[1] Accepted for publication in October 1949.

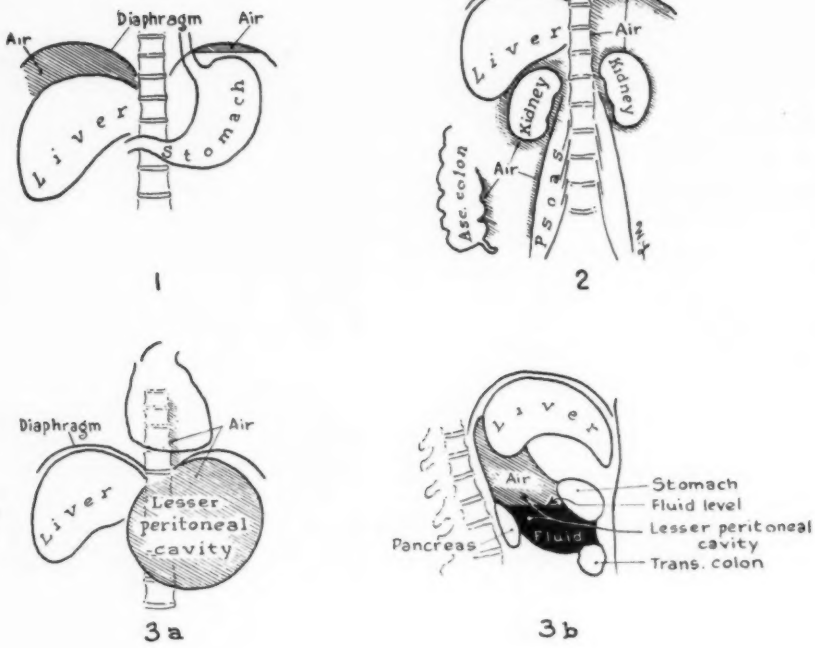


Fig. 1. Schematic drawing of the different types of perforation complicating peptic ulceration. 1. Acute duodenal ulcer perforation, with air beneath the diaphragm. 2. Retroperitoneal perforation, showing air surrounding the kidneys, ascending colon, and psoas area, and ascending on the left side beneath the left diaphragm. 3. Lesser peritoneal sac perforation: (*a*) anteroposterior supine view, showing the lesser peritoneal sac distended with fluid; (*b*) erect lateral view, showing a fluid level with air above the fluid. 4. Chronic perforation adjacent to the ulcer crater, accessory pocket or pseudo-diverticulum type. 5. Walled-off perforation distant from the ulcer. 6. Perforation into other organs.

(2) Pinpoint perforation with escape of air only.
   (*a*) Sealed: surgical type.
   (*b*) Unsealed: medical type.

The chronic type of perforation with an accessory pocket or pseudo-diverticulum is the more common variety of unsealed walled-off pocketing. In the case of a gastric ulcer, the pocket is situated on the lesser curvature of the stomach, and in most instances adjoins the ulcer, appearing as a

large, deep ulcer crater or diverticulum. In the duodenum the site is usually on the inferior and greater curvature side of the base of the bulb. The chronic perforated ulcer of this type has a large opening and readily fills with barium and air. This form of perforation is frequently asymptomatic. However, it does not tend to heal and is thus prone to repeated secondary inflammatory changes, often producing symptoms refractory to medical treatment.

A less frequent form of localized chronic duodenal perforation may present an encapsulated subhepatic or periduodenal pocket, which does not form a part of the crater. The walled-off pouch fills with barium and air during the roentgen examination. This is a persisting form of pocketing with a large hiatal opening connecting with the ulcer, permitting the contents of the viscus free entrance into the pouch.

The site of the pocket in chronic walled-off perforations varies according to the location of the ulcer. When the ulcer occurs on the lesser curvature of the body of the stomach, the pocket usually lies adjacent to the crater. Elsewhere this is less apt to be the case, and because of the close relationship of the ulcer with the body of the pancreas, the pocket is most often imbedded in that organ. In those cases involving the duodenum, the pocket may be situated as an offshoot from the ulcer, forming a sacculation in the periduodenal area or at a distance in the subhepatic region. The walled-off pockets are usually large and often irregular in contour. Since they readily fill with barium, they are more or less easily demonstrated roentgenologically. They may cause pressure on adjacent structures. This type of perforation does not tend to disappear but the pocket is continuously refilled with the contents of the viscus. Often, these cases are asymptomatic at the time of examination, but sooner or later they become a surgical problem.

Little consideration has been given to the pinpoint perforations presenting a walled-off pocket filled only with gas. Of these, there is a medical type, which seals spontaneously, and a surgical non-sealing type, which is progressive in its course.

Fig. 2. A walled-off air-pocket is shown atop the duodenal bulb at arrows A. The deformed duodenal bulb due to a chronic recurring ulceration is shown at arrow B.

In the medical type a minimal amount of air escapes into a small walled-off pocket, forming an air-bubble. This type of perforation must occur with greater frequency than is suspected. It is certain that unless one looks for it, it will be missed in the routine clinical and roentgen examinations. In a recent communication (5) 5 cases are reported. Hitherto the complication had not been recognized. Clinically, this form of perforation is characterized by an acute, subacute, or insidious onset of abdominal distress, of varying severity. It is usually ushered in by vomiting and pain, which is not quickly relieved by the usual form of ulcer treatment. The symptoms are generally not severe, but differ from those which the patient has previously experienced. At times the pain and discomfort are increased by food. The patient is ambulatory and not acutely ill, and the symptoms usually subside within one or two weeks. Roentgenologically, if the case is seen early, a small gas-bubble is observed

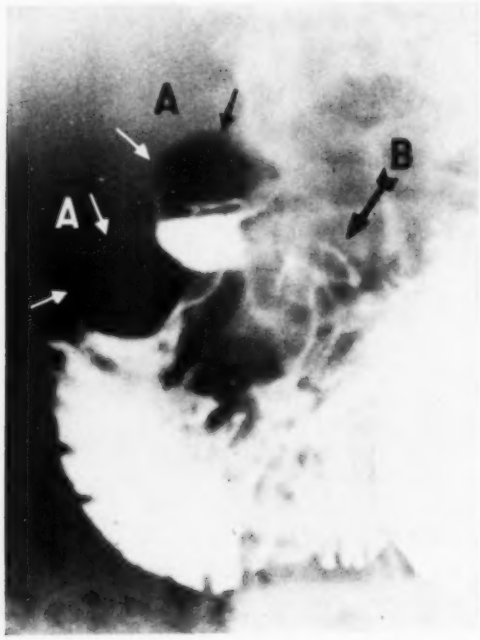


Fig. 3. Double air-pocket in the subhepatic and periduodenal areas at arrows A, due to a subacute perforation of a duodenal ulceration. The deformed duodenal bulb is shown at arrow B.

in the subhepatic region, atop the duodenal bulb. The size of the pocket is about that of an almond. It is smooth in contour and its superior aspect is dome-shaped. A noteworthy feature is the striking similarity of the symptoms and roentgen picture in cases where the subhepatic gas-bubble is encountered in this type of walled-off sealed pinpoint perforation. The ulcer is usually active, most often presenting a niche roentgenologically. In the cases previously reported, there were clinical signs of a chronic recurring duodenal ulcer of from five to twenty-five years duration.

The small gas-bubble, with a minimum amount of air, can be demonstrated only in the erect position during spot-film compression examination; in the recumbent prone position no air pocket is observed. In many cases the gas-bubble could not be seen under the fluoroscope in any position, because of the small amount of air. No communication was demonstrable between the ulcer and the pocket.

The gross pathologic appearance of this type of perforation is that of an ulceration which has perforated to the serosa, together with evidence of an inflammatory exudate producing a matting together of the surrounding tissues, with extensive adhesions, walling off a localized area. Finally, when the pinpoint perforation occurs, the leakage of gas forms the air-bubble described above. As the air is absorbed, there remains the thickened tissue adherent to the serosa.

In the surgical type of walled-off gas-pocket due to a pinpoint perforation, the pocketing is more extensive, and there is an associated localized active peritonitis. The perforation may be sealed or unsealed, but is generally unsealed. While in the medical type the gas in the pocket is readily absorbed, this is not true in the unsealed surgical type of perforation, as there is a continuous leakage of gas into the pocket. The opaque medium does not enter the pouch, because of the minute size of the perforation and the associated edema.

The roentgen diagnosis of perforation of all types is comparatively easy. One must, however, look for the unusual forms and consider their occurrence, or they may not be recognized. The acute perforation into the greater peritoneal cavity is readily diagnosed clinically and confirmed roentgenologically by the demonstration of free air beneath the right diaphragm and/or flank, depending upon the position in which the roentgenograms are made. Lesser peritoneal cavity perforations have not been clearly demonstrated roentgenologically.

The subhepatic or localized gas-pocket is not a new roentgen sign of perforation. The diagnosis of this type of perforation can be made only roentgenologically. In those cases in which barium enters the pocket, the diagnosis is readily made. On the other hand, when only a small amount of air escapes into the pocket, it may be overlooked. It must be emphasized that the smaller pockets cannot always be demonstrated in the usual prone position, but roentgenograms must be obtained in

the upright position. The entry of air into the pocket is influenced by a number of factors, namely, (1) the size of the hiatus of the perforation, (2) sealing off of the opening by overlapping mucosa, (3) mucosal swelling surrounding the perforation, (4) inflammatory serosal swelling and induration, (5) occlusion of the opening by content of the viscus or clot, (6) tortuosity and narrowing of the sinus tract.

Ordinarily gas is readily absorbed from the greater peritoneal cavity, though this may take a week or longer. Gas-pockets are not normally observed in the subhepatic area or adjacent ulcer craters, unless there is a perforation. The amount of air, its absorption, and recognition of the air-pocket following a pinpoint perforation depend upon three factors: (1) whether the perforation is sealed or non-sealed, (2) the size of the pocket, (3) the time interval following perforation. In the sealed, or medical, type with a small air-bubble, the air is rapidly absorbed, while in the non-sealed, surgical type there is a continuous refilling of the pocket, as pointed out above. It is therefore likely that many cases of the medical type are missed in the roentgen study because the examination is made after the air has been absorbed. In the absence of the characteristic gas-pocket the diagnosis of this form of perforation cannot be made.

Peptic ulcer perforation is usually single. However, multiple perforations may occur in some patients. In the 5 cases cited above, there were 2 with multiple perforations.

Acute perforations into the greater peritoneal cavity must be differentiated from other acute abdominal catastrophes. The differential diagnosis of localized gas-pockets is much more difficult. The most common conditions to be considered are trapped air in the duodenum, duodenal diverticulum, and overshadowing of a gas-filled viscus.

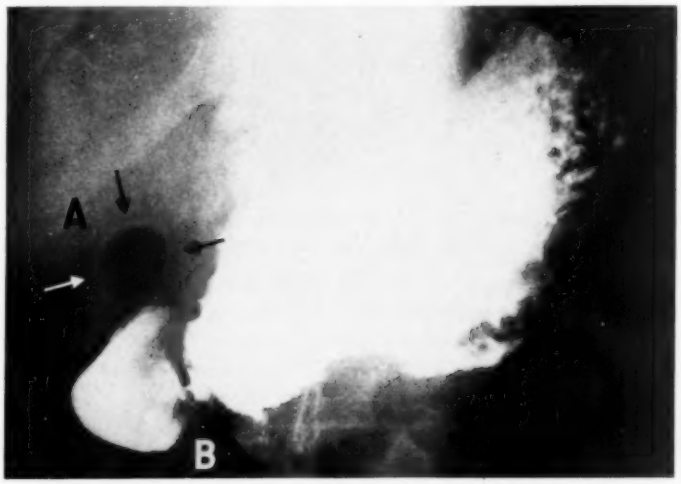


Fig. 4. A gas-pocket in the subhepatic region is shown at arrow A, due to a perforated pyloric ulcer at arrow B.

## SUMMARY

The types of perforation complicating peptic ulcer have been classified and the hitherto inadequately described walled-off perforations have been reviewed. Roentgenologic observations of the different forms of perforation, with a description of each type, are presented.

The most common form is that involving the greater peritoneal cavity. Perforations into the lesser peritoneal cavity have received little attention, and it is suggested

that the condition has frequently been overlooked. Retroperitoneal perforations are uncommon but occasionally occur when the posterior wall of the distal portion of the duodenum is involved. Attention is especially directed to the localized walled-off types of perforation and to a medical type which has not been previously reported. These pinpoint perforations are not an uncommon complication in recurrent active duodenal ulceration. The roentgen examination will portray a small subhepatic or periduodenal air-pocket, which is best observed in a spot compression film made with the patient erect. The examination must be made early before the absorption of the gas.

REFERENCES

1. SINGER, H. A., AND VAUGHAN, R. T.: "Formes Frustes" Type of Perforated Peptic Ulcer. Surg., Gynec. & Obst. **50:** 10–16, January 1930.
2. SINGER, H. A., AND VAUGHAN, R. T.: Treatment of the "Forme Fruste" Type of Perforated Peptic Ulcer. Surg., Gynec. & Obst. **54:** 945–952, June 1932.
3. MORRISON, M. C.: Radiological Findings in Lesser Sac Effusion. Canad. M. A. J. **52:** 474–477, May 1945.
4. FELDMAN, M.: Lesser Peritoneal Cavity Perforation Complicating Peptic Ulcer. Gastroenterology **15:** August 1950.
5. FELDMAN, M.: Localized Sealed-Off Perforation in Recurrent Duodenal Ulcer. Am. J. M. Sc. **218:** 378–383, October 1949.
6. FELDMAN, M.: Localized Walled-Off Gas-Pockets Due to Perforation Complicating Peptic Ulceration and Gastric Carcinoma. Gastroenterology. In press.

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SUMARIO

**Perforación de Ulcera Péptica: Consideración Roentgenológica de las Varias Formas y Tipos Raros de Perforación**

Tiene por objeto este trabajo clasificar las formas de perforación que complican la úlcera péptica y repasar las formas emparedadas hasta ahora inadecuadamente descritas. Al presentar observaciones roentgenológicas de las diversas formas, se describe cada una de éstas, comprendiendo perforaciones: (1) a la cavidad peritoneal mayor, (2) a la cavidad peritoneal menor, (3) retroperitoneales, (4) emparedadas localizadas, y (5) a otros órganos.

Llámase en particular la atención sobre las formas emparedadas localizadas y sobre una forma médica que no había sido descrita antes. Estas perforaciones en punta de alfiler no constituyen una complicación rara en la úlcera duodenal activa recurrente. El examen roentgenológico mostrará una bolsilla subhepática o periduodenal de aire, que se observa mejor en una radiografía instantánea de compresión, tomada con el enfermo de pie. Hay que hacer el examen pronto, antes de la absorción del gas.

# Radiation Therapy of Carcinoma of the Cardia[1]

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ALTHOUGH THE first cancer to be treated by exposure to roentgen rays was a carcinoma of the stomach, reported by Despeignes (1) in 1896, radiation therapy of carcinoma of that organ has fallen into disrepute. There are many causes for the prevailing pessimism. Ninety per cent of all gastric carcinomas are believed to be insensitive to roentgen rays, though it should be noted that no adequate method exists for determining the radiosensitivity of any individual tumor. The mobility of the stomach makes it difficult for the roentgenologist to direct his cross-fire accurately. The concomitant irradiation of liver, pancreas, and adrenals proved a temporary deterrent. The good general health frequently associated with tumors in other locations, such as the breast and skin, is usually absent in carcinoma of the stomach, and the accompanying cachexia makes these patients less able to stand the radiation sickness, with its attendant nausea and vomiting. Aside from such handicaps, necrosis of a tumor that is radiosensitive may produce perforation and hemorrhage.

Many attempts have been made to overcome these difficulties. Holfelder (3) utilized a compression diaphragm in order to reduce the distance between the target and the tumor. Attempts were made to fix the stomach to the anterior abdominal wall prior to irradiation. Scholz (4) recommended barium-filling of the stomach in order to utilize secondary radiation and to protect adrenals and pancreas. In spite of these and other efforts to solve the problem, a deep gloom was manifested by the majority of influential authors, and cancer of the stomach was generally classified as not amenable to irradiation. As recently as 1933, Kaplan (5), in a report of over a thousand unselected cancer cases, briefly dismissed the irradiation of gastric carcinoma as of little value. Pack (6), in his latest monograph on cancer of the esophagus and gastric cardia, discusses radiation therapy of carcinoma of the esophagus by Nielsen's rotation technic, but he does not mention results in carcinoma of the cardia.

When evaluating the radiosensitivity of carcinomas of other organs it is not customary to group them together indiscriminately. In spite of repeated attempts, however, no reliable criteria, either gross or microscopic, have been found for predicting the sensitivity of gastric carcinomas. Pack (7), who has written extensively on this subject, utilized the classification of Ewing (2). He describes the bulky adenocarcinoma as being likely to regress under radiation treatment when situated at the cardia or fundus. Carcinoma telangiectatica, a type of medullary cancer or carcinoma simplex, is sometimes sensitive to radiation; it occurs chiefly in the fundus and cardia. The carcinomatous ulcer is described as occasionally radiosensitive, and the anaplastic small-cell gastric cancer as radiosensitive. It is interesting to note that most of these tumors are frequently located in the proximal portion of the stomach. Pack (7) declares it as his experience that "the most radiosensitive gastric cancers are located in the cardia and fundus."

The cardia and the fundus are the site of about 10 per cent of all gastric carcinomas. Many of these produce dysphagia and eventually complete obstruction of the cardia, resulting in agonizing cachexia prior to death. The treatment of choice for lesions in this location is surgical excision by resection of the cardia or by total gastrectomy—even if palliation is all that can

[1] From the Department of Medicine, College of Medical Evangelists, Los Angeles, Calif. Accepted for publication in October 1949.

be attained. This, however, is not always possible. If the tumor is surgically inoperable, or if the general condition of the patient does not permit major surgery, or if permission for operation is not granted, the use of radiation therapy should not be withheld. The 3 following cases will serve to illustrate the response of tumor of the cardia to radiation therapy and the striking relief of symptoms in such patients. In 2 of the cases microscopic verification of the clinical diagnosis was possible.

## CASE REPORTS

CASE 1: This case was seen by the senior author in Munich in 1929, and the initial results of the radiation treatment were described by Sielmann (8). The patient had lost 60 pounds within half a year. She complained of dysphagia and epigastric pain. Roentgen examination revealed a mass obstructing the cardia, with invasion of the lesser and greater curvature. Only a very thin stomach tube could be passed into the stomach, after a marked resistance at the cardia was overcome. On its withdrawal, the tube was smeared with blood. The gastric juice did not contain free hydrochloric acid; it contained blood. Thereupon the diagnosis of carcinoma of the cardia was made.

At that time the Coutard method of deep irradiation had found recognition. In consideration of the good results obtained by this technic in carcinomas of the pharynx, etc., it was decided to try it in this instance. A full tumor dose[2] was directed at the cardia through two portals in the course of several weeks.

In the beginning of the treatment, the patient, who was very weak, continued to lose weight, but her condition then improved. The dysphagia and the pain subsided. At the end of the irradiation the gastric contents revealed many mucus-producing and pus cells. Bacteriologically, *Staphylococci*, *Streptococci*, and *B. coli* were found. The patient complained of a marked sweetish taste and experienced violent vomiting. A thick Ewald tube (French 36) was readily introduced into the stomach, after which introduction of a rigid gastroscope was tried. This passed easily into the stomach, and inspection revealed a superficial type of gastritis. No tumor or residue of a tumor was seen. At roentgen examination the esophagus was wide and permeable. In view of these observations, we assumed that our diagnosis had been wrong, as we could not believe that a carcinoma of the cardia could disappear so completely.

For one year the patient was not seen. A report was then received that she had died from an ileus. Autopsy revealed carcinomatous metastases in the mesentery, which had led to strangulation and obstruction. The stomach appeared grossly normal. Only microscopically scant nests of scirrhous carcinoma were found.[3]

The observation of this case seems to prove that a scirrhous carcinoma of the cardia may react to deep roentgen therapy in such a way that it disappears grossly, and that dysphagia and pain are relieved. The life of the patient was probably materially prolonged.

CASE 2: This case will be reported only briefly as it was not proved microscopically. The patient was a 71- year-old white male with dysphagia and a tumor which was seen to protrude into the air bubble of the stomach on roentgen examination. It encroached upon the esophagus. Surgical interference did not seem advisable because of the patient's poor general condition. In consultation with Dr. Max Cutler of Chicago, it was decided to try irradiation. This was done by Dr. Morris Horwitz, with most gratifying results. The cardiac portion of the tumor, as seen roentgenologically, became much smaller and the dysphagia improved. Death ensued after fourteen months. Because of the age of the patient, it seems most likely that the lesion was a carcinoma of the cardia, which reacted favorably to roentgen irradiation. This, however, was not proved microscopically.

This type of case—with roentgen observation of the shrinking of a tumor of the cardia after irradiation—has been described repeatedly by Pack and other authors. The third case, however, was unusually well observed, since the patient had two laparotomies and an autopsy was done.

CASE 3: A 68-year-old white male physician was referred to us on Oct. 31, 1946. For the past twelve months he had experienced increasing abdominal distress. Eating was interrupted by epigastric pain, and there was some loss of appetite, with a 12-pound weight loss. Introduction of an Ewald tube produced abdominal pain (such as was felt during eating), and the progress of the tube was obstructed at the level of the cardia. At roentgen examination a large, rounded mass was observed protruding into the air bubble at the cardia (Fig. 1). This tumor involved the lesser curvature and extended to the greater curvature. The duodenal cap revealed multiple small filling defects.

On Nov. 15, 1946, a laparotomy was performed by

[2] Just what the dosage was cannot be stated, since the case records are no longer available. It was probably in the neighborhood of 3,000 r.

[3] The microscopic material has been lost.

Fig. 1. Case 3. Roentgen picture of stomach with double-contrast technic. Large tumor of cardia and fornix, coated with barium, protruding into the air bubble.

Dr. Maurice Brown (San Diego), and a major portion of the upper third of the stomach was found to be involved in a firm, hard tumor, with infiltration into the gastrohepatic and gastrosplenic ligaments. Carcinomatous infiltration was also observed in the prepyloric area. A biopsy was taken and a Stamm gastrostomy was performed. Microscopic examination revealed adenocarcinoma, Grade 2 (Fig. 2).

Fig. 2. Case 3. Microscopic section of the tumor demonstrated in Fig. 1, obtained at laparotomy. Adenocarcinoma, grade 2.

The observation of the two cases described above led to the recommendation of roentgen therapy. This was done by Dr. R. F. Niehaus (San Diego). A total of 300 r (measured in air) to each of three portals was administered immediately after surgery. One month after operation, over a period of a month, the patient received 1,200 r (in air) to each of three ports, anterior, lateral, and posterior, measuring 10 × 15 cm., the factors being 250 kv., h.v.l. 2 mm. Cu, and 50 cm. distance. Treatments were given daily (Dec. 16, 1946, to Jan. 14, 1947), the daily dosage varying from 90 to 120 r (in air). Because of intense weakness and nausea, the treatment was discontinued. On Feb. 18, 1947, roentgen examination revealed a small mass on the lesser curvature near the cardia, with a filling defect and elongation of the pylorus. Therapy was reinstituted by Dr. Niehaus on March 7. This time, at our suggestion, the pylorus was visualized fluoroscopically with small amounts of barium prior to each treatment. A dose of 1,000 r (in air) was administered to anterior and posterior ports, cross-firing the pyloric region. The patient began to gain weight—25 pounds in the subsequent months—his appetite improved, and distress during eating became negligible. Irradiation was completed on April 10.

Fig. 3. Case 3. Roentgen picture of stomach after x-ray irradiation. Double contrast technic, as in Fig. 1. No tumor visible.

Careful roentgen examination of the stomach with double contrast technic on Sept. 9, 1947, failed to reveal any abnormality (Fig. 3). On Oct. 6 an Ewald tube could be readily introduced into the stomach, and gastroscopy became possible. A careful gastroscopic inspection failed to reveal any trace of tumor. This improvement lasted for about eleven months, after which evidence of intestinal obstruction developed.

A second laparotomy was performed on March 3,

1948. Careful palpation of the stomach, during the course of the operation, from the cardia to the duodenum, revealed no evidence of infiltration. Numerous carcinomatous implants were found in the liver, omentum, large bowel, and pelvis. The patient died Nov. 7, 1948, two years after the first laparotomy, following a second acute intestinal obstruction.

At autopsy (Dr. D. A. De Santo and Dr. J. McBirnie) gross examination of the stomach revealed no definite evidence of intrinsic tumor. There was dense scar tissue between the anterior wall of the stomach and liver, and the posterior wall was puckered by perigastric adhesions. Microscopic sections from the cardia revealed minimal residual carcinoma, with extensive radiation effect. Other areas of the cardia showed radiation fibrosis and atrophy. Metastases were found in the liver, diaphragm, and peritoneum. Acute intestinal obstruction, due to metastases, was present.

In this third case the carcinoma had invaded not only the cardia but lower mobile portions of the stomach. We believe that the spectacular result of the treatment was due to the technic used. Before each single irradiation, the position of the stomach was checked by fluoroscopy after the patient had swallowed a small amount of barium suspension. The fluoroscopy was done in the position used for the irradiation. Thereby it became possible to know the exact position of the mobile stomach each time and to choose portals and direct the rays accordingly.

The course of Cases 1 and 3 is rather similar. In each an obstructing carcinoma of the cardia reacted to deep roentgen therapy so thoroughly that at gastroscopy no tumor was seen, and the obstruction disappeared completely. Life was markedly prolonged in each instance, but both patients succumbed to an ileus caused by metastases. In Case 3, the extent of the tumor before the irradiation and its disappearance after the irradiation were checked by two laparotomies. In Case 1 a scirrhous carcinoma and in Case 3 an adenocarcinoma was found; yet both reacted equally well to roentgen irradiation, only a minimal residue of the tumor being found in the gastric wall. It is doubtful if this type of treatment can accomplish a cure. It is able, however, to relieve distress, to eliminate obstruction, and to prolong life. It should be tried in cases of carcinoma of the cardia in which radical operation is impossible.

## SUMMARY

1. In 3 patients with clinical carcinoma of the cardia the tumor reacted favorably to deep roentgen irradiation. One case was verified at autopsy, and one by two laparotomies and autopsy. In these two cases the tumors within the stomach had disappeared except for minimal microscopic residues. Metastases led to the fatal end. Distress was relieved and life prolonged.

2. It is easy to reach a tumor of the fixed cardia with the proper amount of radiation. If the tumor involves mobile portions of the stomach, its position should be determined, prior to each irradiation, by fluoroscopy after the ingestion of a small amount of barium, with the patient in the position to be used at that treatment.

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## REFERENCES

1. DESPEIGNES, V.: Observation concernant un cas de cancer de l'estomac traité par les rayons Röntgen. Lyon méd. **82:** 428, 1896.
2. EWING, J.: An Analysis of Radiation Therapy in Cancer. Radium Report of Memorial Hospital. New York, Paul B. Hoeber, Inc., 2d series, 1923.
3. HOLFELDER, H.: Methodische Fortschritte der Röntgentherapie der Krebse des Verdauungskanals. Strahlentherapie **42:** 497–503, 1931.
4. SCHOLZ, T.: Application of Roentgen Radiation to the Barium-Filled Stomach. A Contribution to the Radiation Treatment of Inoperable Gastric Tumors. Radiology **18:** 269–276, February 1932.
5. KAPLAN, I. I.: A Report of Over a Thousand Unselected Cancer Cases, Treated in 1931–1932, at the New York City Cancer Institute, Welfare Island. Radiology **20:** 433–449, June 1933.
6. PACK, G. T.: Cancer of the Esophagus and Gastric Cardia. St. Louis, Mo., C. V. Mosby Co., 1949.
7. PACK, G. T., SCHARNAGEL, I. M., QUIMBY, E. H., AND LOIZEAUX, M. C.: Palliative Irradiation of Gastric Cancer. Arch. Surg. **31:** 851–896, December 1935.
8. SIELMANN, H.: Erfahrungen mit der Röntgentiefenbestrahlung nach Coutard bei maligen Neubildungen. München. med. Wchnschr. **78:** 360–365, Feb. 27, 1931.
9. WARING, H. J.: Surgical Treatment of Malignant Disease. New York, Oxford University Press, 1928.

SUMARIO

**Radioterapia del Carcinoma del Cardias**

En 3 enfermos con carcinoma del cardias, diagnosticado clínicamente, el tumor reaccionó favorablemente a la roentgenoterapia profunda. En 2 casos comprobados en la autopsia los tumores intragástricos habían desaparecido, salvo por mínimos residuos microscópicos. Las metástasis condujeron al desenlace letal, pero se había aliviado el malestar y prolongado la vida.

Con una dosis apropiada de irradiación resulta fácil alcanzar un tumor del cardias fijo. Si el mismo afecta porciones movibles del estómago, antes de cada irradiación hay que determinar su posición por medio de la roentgenoscopia, después de la ingestión de una pequeña cantidad de bario, y con el enfermo colocado en la posición que va a usarse en el tratamiento dado.

# Segmental Collapse in Therapeutic Pneumothorax[1]

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THE BASIC RATIONALE of collapse therapy in pulmonary tuberculosis is the clinical observation that a massive pleural effusion which is superimposed on a severe pulmonary lesion generally brings about general improvement. Although tried by others, pneumothorax was first systematically applied by Forlanini. He and his co-workers, as well as subsequent investigators, believed that a diseased lung immobilized by maintaining a pneumothorax with markedly positive pressure would heal because of functional rest. In the development of pneumothorax treatment, there was one further important step, namely, the recognition by Ascoli (1) in 1912, that partial pulmonary collapse by subatmospheric intrapleural pressures, "hypotensive pneumothorax," produced better results. At approximately the same time Parry Morgan (2) reported some experimental work on the pathogenesis of selective collapse and probably was the first to start the controversy regarding "elastic recoil of the lung."

Some years later Barlow and Kramer (3) coined the phrase "selective collapse," describing their technic for achieving collapse of the diseased lobe. Further studies indicated that selective collapse was achieved without any special attempt on the part of the therapist other than maintaining a relatively negative pressure in the intrapleural space. The mechanism by which selective collapse was achieved, received and continues to merit some discussion. Of all the investigations reported in the literature, the most noteworthy have been those of Coryllos (4), whose critical studies on the role of bronchial obstruction have been quite generally accepted.

Working especially in an investigation of the localization of lung abscess, Kramer and Glass (5) were the first to describe the bronchopulmonary segment and to project its anatomical unit to the chest wall. Further studies, especially for the purpose of resection, have been recorded by Brock (6), Foster-Carter (7), and others.

It is our belief that tuberculosis is essentially a segmental and sub-segmental pathological process. It has been amply demonstrated by Meissner (8), Silverman (9), and others interested in tracheobronchial tuberculosis that the most frequent lesion occurs in the finer bronchial ramifications. If a tuberculous lesion is present in a segment or sub-segment, the branch bronchus is usually involved in the same process. At the very least these bronchi are edematous, have little or no ciliary movement, and are partially filled with caseous material, desquamated mucosal epithelium, and other detritus. With the institution of pneumothorax, the normal lengthening and shortening and dilatation and contraction of the bronchial tree are reduced, again tending to collapse of the segment or a division thereof. If then the damage in the branch bronchus or bronchi is accepted as an inevitable concomitant of the disease, it is but a short step to understand the mechanics of segmental or lobular collapse. The normal lung is permanently on stretch even in full expiration, and its power of elastic recoil enables it to retract at any time it is given the opportunity. All forms of collapse lead to shrinking, and the bronchi participate by becoming similarly narrower and shorter.

## ROENTGEN FINDINGS

In a pneumothorax where adhesions are absent, whether by virtue of an intrapleural

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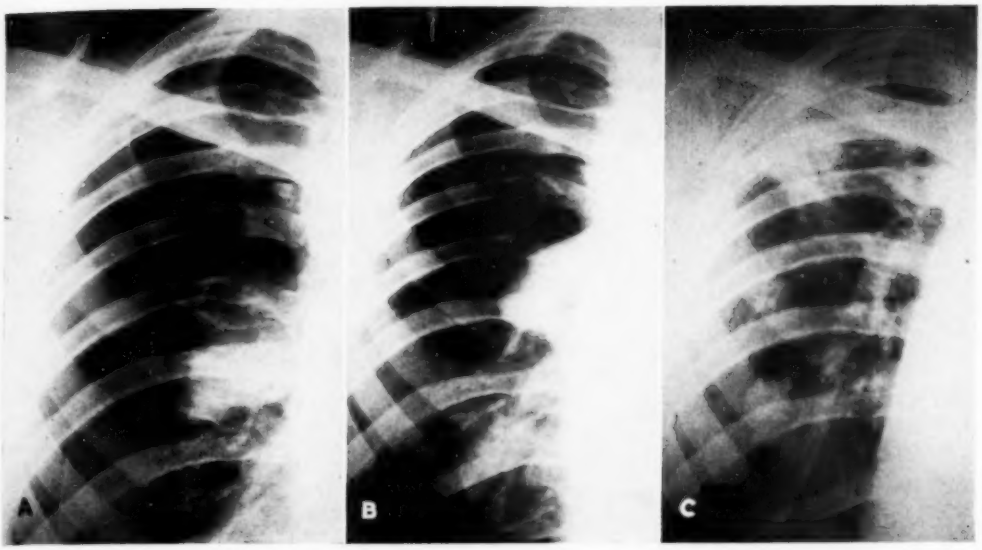


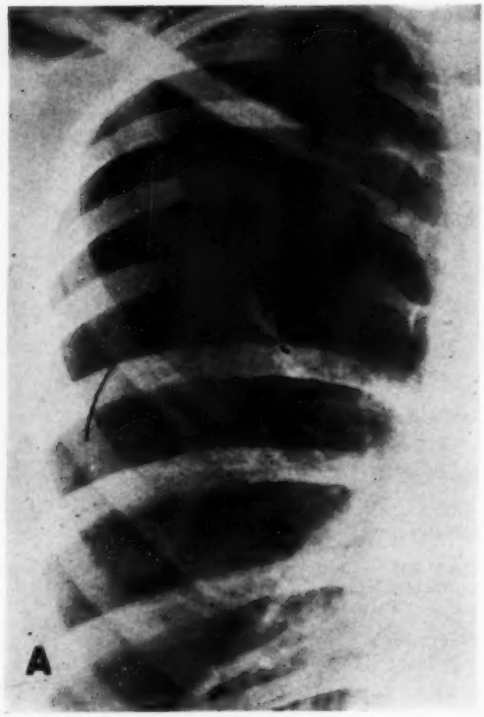

Fig. 1. Case I. A. Selective collapse of the dorsal segment of the right upper lobe. B. Section of adhesions, with continuation of pneumothorax, has resulted in lobar atelectasis. C. Total re-expansion of right lung. The density in the right upper lobe represents the contracted dorsal segment.

pneumonolysis or not, the most perfect form of selective collapse may be seen. This is first noted very early on the roentgenogram as a local condensation of the diseased area with a "dipping in" of the pleura, producing in many instances a scalloped effect. The collapsed area may retract toward the hilus to such an extent as to be difficult, finally, to recognize as a contracted segment. In some cases it may assume a rounded appearance and be indistinguishable from a round focus, having lost its anatomical relationship to the remainder of the lobe. This latter degree of shrinkage is a slow process, taking weeks to months as compared with the original "dipping in," which appears very quickly. If the collapse is increased to too great a degree, the fine differential between the selectively collapsed diseased area and the remainder of the more normal lung is lost. The scalloped, dipped appearance of the pleural surface disappears until some re-expansion occurs and the fine changes are once more demonstrable.

With the development of a pleural effusion, the visceral pleura becomes thickened due to deposition of fibrin. Unless the segmental collapse has persisted for a considerable period, there is a tendency to lose the radiologic wedge-like and scalloped appearance. This same point is true in re-expansion of pneumothorax unless the collapse has been maintained for a period of years.

In some cases studied there has been a changing evanescent quality to the segmental atelectasis with appearance and disappearance of the segmental selective collapse. When this is added to cases such as Case V, in which the original roentgenogram showed a segmental collapse which changed back and forth and finally terminated in a lobar collapse, a rather obvious conclusion of spreading bronchial disease may be drawn. Regardless of the factors of elasticity, neurovascular phenomena, reflex mechanisms, as well as others, it would appear that the major etiology of selective collapse rests upon bronchial obstruction. That this is largely due to edema of the 3rd, 4th, and 5th order bronchi may be shown by the changing character of the radiologic findings.

CASE I (Fig. 1): E. G., a white male, age 30, was admitted to the hospital April 1, 1944. Onset of his




disease had occurred eighteen months previously with cough, expectoration, and fever. Artificial pneumothorax was initiated March 4, 1943, but the sputum remained positive. On admission, the pneumothorax was continued, and it was noted that there was some selective collapse of the dorsal segment of the right upper lobe. Two different attempts were made at intrapleural pneumolysis with further selective collapse. Although the dorsal segment originally showed greatest collapse, the entire right upper lobe participated, collapsing to a small round dense mass. With re-expansion after more than four years of pneumothorax, the greatest portion of the right upper lobe re-aerated, while the dorsal segment remained dense and apparently atelectatic.

CASE II (Fig. 2): E. K., a white female, age 19, was first admitted to the hospital on March 27, 1947. Diagnosis had been made on a routine chest roentgenogram two months previously. On admission bilateral exudative productive infiltrations were present in both apices and subapical areas. There was suggestive cavitation on the right and, following the finding of a positive sputum, a right artificial pneumothorax was induced. Intrapleural pneumolysis was performed on the right on May 24, 1947, but sputum remained positive and slight progression was noted on the left Consequently, left artificial pneumothorax was induced, followed by intrapleural pneumolysis on that side. Chest roentgenograms

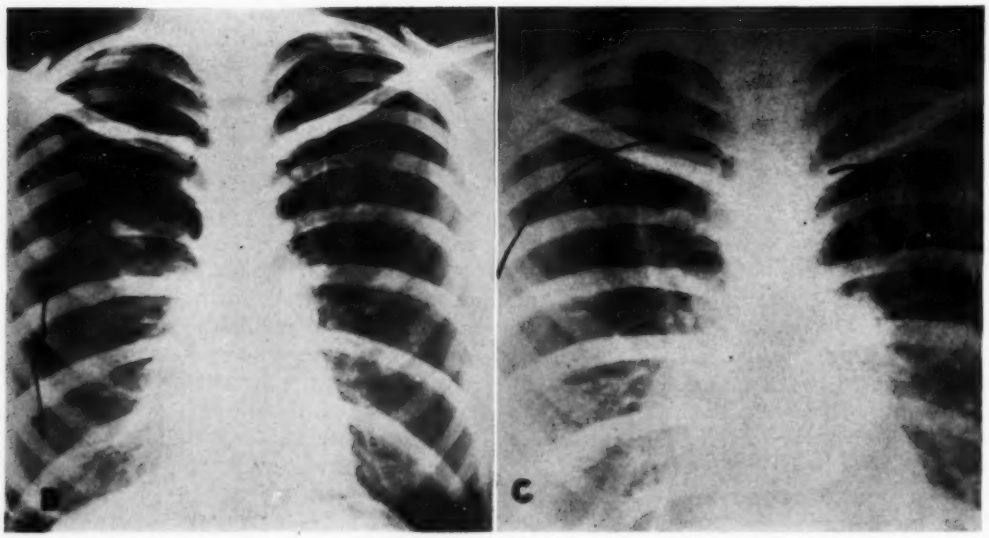



Fig. 2. Case II. A. Right pneumothorax with two sub-segments selectively collapsed. Note the dipping in of the lung in these areas.
B. Left pneumothorax has been instituted, but the upper lung field is suspended by multiple adhesions.
C. The adhesions on the left have been sectioned, resulting in selective sub-segmental collapse. On the right there has been retraction of the segment toward the hilus, with loss of dipping-in appearance.

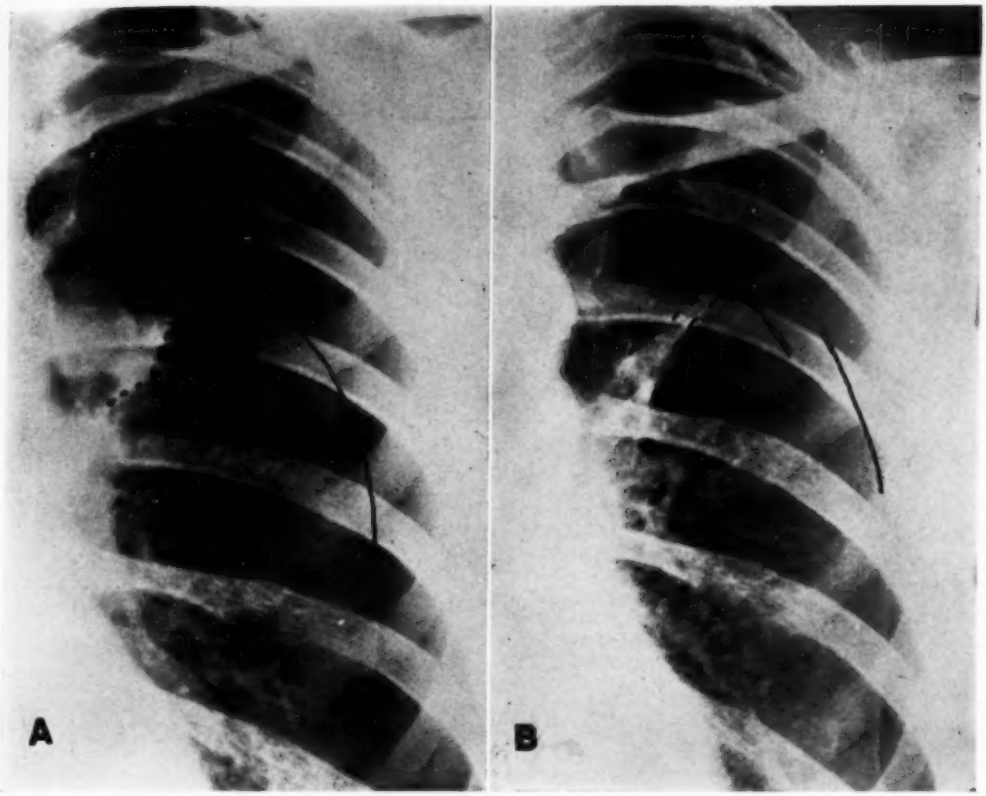



Fig. 3. Case III. A. Left pneumothorax with collapse of the apical segment of the left upper lobe. B. With continuation of pneumothorax, there has been re-aeration of the major portion of the apical segment, leaving a small sub-segment collapsed.

showed a tendency to bilateral segmental and subsegmental collapse. On the right side the normal "dipping in" commonly seen in true selective collapse disappeared as the collapsed area was converted into a small "round focus." The "dipping in" has continued on the left, as may be seen.

CASE III (Fig. 3): M. W., a white female, age 25, was admitted on April 15, 1946. She stated that all roentgenograms prior to November 1945 were negative but, following an upper respiratory infection, a density was noted in the left upper lung field. On admission, the sputum was consistently positive and the film showed an exudative productive lesion in the left apex and subapical area. Bronchoscopy on May 18, 1946, revealed an ulcerative lesion in the left stem bronchus, which was treated on numerous occasions with local application of silver nitrate. By Aug. 17, 1946, the lesion could no longer be seen but was suspected of being present further along, beyond bronchoscopic visualization. A pneumothorax was induced on the left on Dec. 9, 1946, with rapid appearance of a selective collapse of the apical segment. The sputum remained positive but, following a three month course of streptomycin, became consistently negative. The selective collapse of the apical segment was replaced by that of a small sub-segment.

CASE IV (Fig. 4): P. Y., a Chinese male, age 24, entered the hospital on Sept. 13, 1948, with a history of a fistula *in ano* developing one month previously. A chest roentgenogram revealed an exudative productive lesion in the right apex and first anterior interspace. In spite of bed rest and streptomycin, there was no improvement. Right pneumothorax was initiated Oct. 29, 1948, and a right intrapleural pneumolysis was performed on Jan. 7, 1949. The sputum was converted and segmental collapse was noted. On progressive films the segmental collapse may be seen to have retracted further.

CASE V (Fig. 5): B. S., a white female, age 36, was admitted to the hospital on July 26, 1948, because of fresh exudative tuberculosis in the right upper lobe. The original onset was in 1936, when a segmental tuberculous pneumonia on the left was diagnosed. Pneumothorax was induced on that side and x-ray

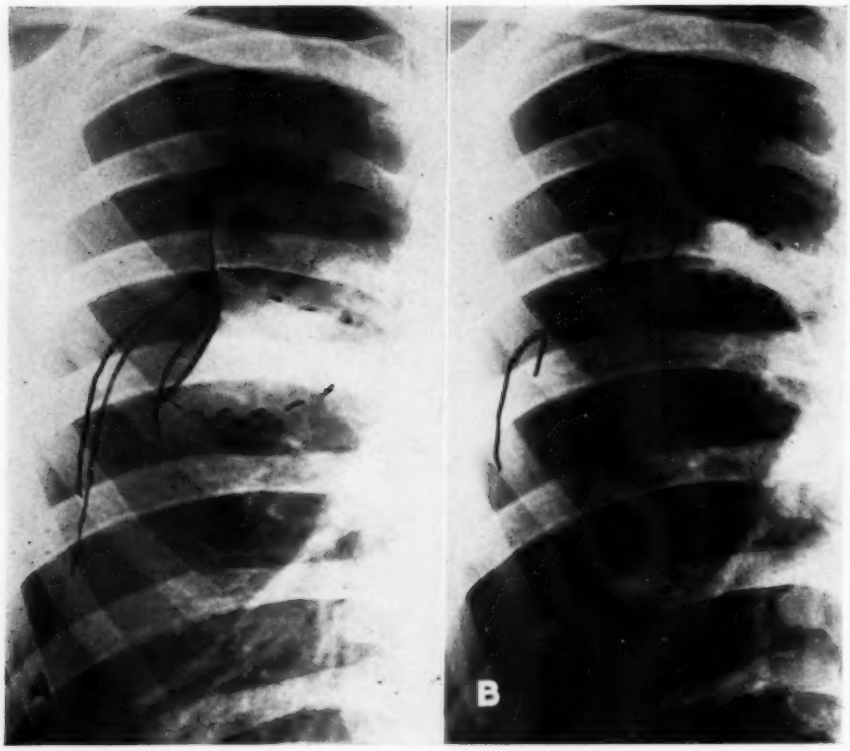



Fig. 4. Case IV. A. Early in course of right pneumothorax, dorsal segment shows selective collapse. B. The segment continues to retract, producing a more marked scalloped appearance of the lung.

(Fig. 5A) showed a segmental collapse of a selective nature. Pneumothorax was continued for seven years and following re-expansion a partially calcified "round focus" could be seen (Fig. 5B). After a period of work, symptoms reappeared, and after a course of bed rest and streptomycin, right pneumothorax was induced. Wheezing had been noted, but no obvious endobronchial disease could be found. Intrapleural pneumolysis was performed on the right, with the immediate development of a segmental collapse. Since that time, with the continuation of pneumothorax for the past year, there have been periods of wheezing with continued positive sputum. The roentgenograms have shown frequent changes ranging from segmental collapse to almost complete atelectasis of the right upper lobe. It is interesting to note that, in spite of the excellent collapse, the cavity is still obviously patent.

## SUMMARY

The mechanism of selective segmental collapse in therapeutic pneumothorax for pulmonary tuberculosis is described, and the importance of the segment and sub-segment as the major unit of collapse is discussed.

The radiologic findings of segmental collapse, as well as the fluctuations in such cases, point to bronchial obstruction especially of the finer branches as the etiologic factor involved.

Illustrative cases of selective collapse of sub-segments, segments, and lobes are presented.

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## REFERENCES

1. ASCOLI, M.: Pneumotorace ad ipotensione. Seventh Congress of Tuberculosis, Rome, 1912. Cited by Coryllos.

2. MORGAN, P.: Artificial Pneumothorax in the Treatment of Pulmonary Tuberculosis. Quart. J. Med., Oxford, 1913. Cited by Coryllos.

3. BARLOW, N., AND KRAMER, D.: Selective Collapse Under Partial Pneumothorax. Am. Rev. Tuberc. €: 75–94, April 1922.

4. CORYLLOS, P. N.: Pathologic Physiology and Mechanics of Selective Collapse: Critical Study.

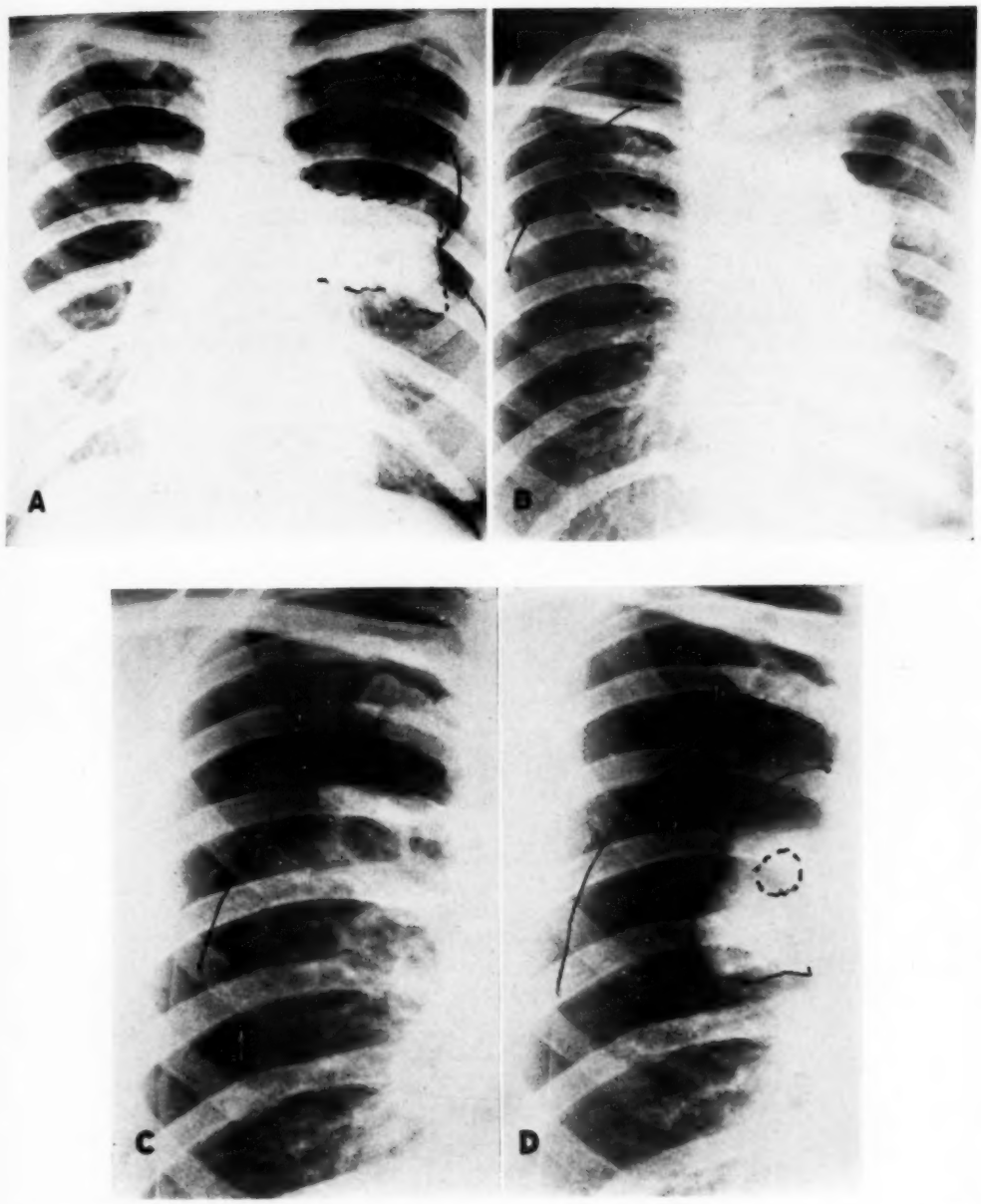


Fig. 5. Case V. A. In 1936, left pneumothorax was induced with selective segmental collapse.
B. Nine years later the left pneumothorax has expanded, and a dense oval shadow represents the previously collapsed segment. On the right, pneumothorax has been induced, with two sub-segments selectively collapsed.
C. A cavity has reopened in spite of an excellent collapse.
D. Almost the entire right upper lobe is now selectively collapsed, with a patent cavity still present.

Quart. Bull., Sea View Hosp. **2:** 244–263, April 1937.
5. KRAMER, R., AND GLASS, A.: Bronchoscopic Localization of Lung Abscess. Ann. Otol., Rhin. & Laryng. **41:** 1210–1220, December 1932.
6. BROCK, R. C.: The Anatomy of the Bronchial Tree. London, Oxford University Press, 1947.
7. FOSTER-CARTER, A. F.: Anatomy of the Bronchial Tree. Brit. J. Tuberc. **36:** 19–39, January 1942.
8. MEISSNER, W. A.: Surgical Pathology of Endobronchial Tuberculosis. Dis. of Chest **11:** 18–25, January-February 1945.
9. SILVERMAN, G.: Tuberculosis of the Trachea and Major Bronchi. Dis. of Chest **11:** 3–17, January-February 1945.

SUMARIO

**Colapso Segmental en el Neumotórax Terapéutico**

Después de describir el mecanismo del colapso segmental selectivo en el neumotórax terapéutico ejecutado por tuberculosis pulmonar, discútese la importancia que revisten el segmento y el subsegmento como principal unidad del colapso.

Los hallazgos radiológicos de colapso segmental, así como las fluctuaciones observadas en esos casos, apuntan a la obstrucción bronquial, en particular de las ramas más delicadas, como factor etiológico.

Preséntanse casos de colapso selectivo de subsegmentos, segmentos y lóbulos.

# Sacroiliac Joint Changes in Traumatic Paraplegics[1]

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IN A RADIOGRAPHIC survey of the pelvic areas of 160 paraplegics we found two main groups of abnormalities: (1) the so-called para-osteo-arthropathies, (2) true arthropathic changes in the sacroiliac joints.

Dejerine, Ceillier, and Dejerine (1) coined the term "para-osteo-arthropathies" to describe bony erosion, soft tissue calcification, and ossification in their series of paraplegic casualties of World War I. The term has been revived, and the studies expanded in several series of World War II patients (2, 3). The bony erosions of the femoral trochanters, ischial tuberosities, and other bony promontories have been ascribed to pressure necrosis and osseous devitalization secondary to decubiti. The soft-tissue calcification and ossification in the buttocks and about the hip joints have also been ascribed to decubiti, but a neurogenic factor may also be involved (2). Another factor to be considered is the abnormal mobilization and deposition of skeletal calcium in the bedridden patient (3).

True joint changes in these patients, in the apophyseal and sacroiliac joints, have been described only recently in the literature (4). Brailsford (5, 6) pointed out that the joint surfaces of the femora and acetabula are characteristically uninvolved and Charcot joints do not occur.

In our series definite sacroiliac joint changes were noted in 98 cases, or about 61 per cent. The changes varied from minimal para-articular rarefaction and narrowing of the joints to apparently complete bony fusion. In 28 patients the findings were classed as slight, although definite; in 26 the changes were moderately to markedly severe, while in 44 complete or almost complete bony fusion was present bilaterally. The sacroiliac films were in many cases quite suggestive of a rheumatoid arthritis of the Marie-Strümpell type. The spine films in our series, however, are usually free of abnormalities, except for the vertebral fractures and immediate secondary changes.

Fig. 1. Partial obliteration of both sacroiliac joints with para-articular rarefaction on the right.
Patient A. S., white male aged 59, sustained a compression fracture of L-1 on Sept. 18, 1926; paraplegia with motor level at S-1 and sensory level at L-4. For ten years prior to admission he was confined to bed and wheel chair and had decubiti over the coccyx and right buttock.

In all of our patients paraplegia was due to fractures of the spine and spinal cord section or to cauda equina injury. In all but three the injuries occurred as a result of rock falls and cave-ins in coal mines. The miner characteristically works in a semi-crouched position, which serves in part to explain why the vertebral fractures oc-

[1] From the Department of Radiology, Permanente Foundation Hospital, Oakland, Calif. Accepted for publication in October 1949.

Fig. 2. Oblique views of right and left sacroiliac joints showing bony bridging of distal thirds of both joints.
Patient O. K., white male aged 38, sustained a compression fracture of T-12 on Sept. 18, 1943; paraplegia with motor and sensory level at T-6. Patient bedridden for five years prior to admission; had several healed decubiti.

Fig. 3. Sacroiliac fusion bilaterally, with cystic rarefaction of the bone in the region of both joints.
Patient C. C., white male aged 33, sustained a compression fracture of T-12 on Oct. 21, 1938; paraplegia with motor level at L-1 and sensory level at T-11. Patient bedridden for ten years prior to admission.

curred at the T-12 to L-1 level in 80 per cent of our cases. The site of the residual central nervous system lesion was quite variable, extending from the mid-thoracic to sacral level.

Low back pain is an occupational complaint of coal miners due to the crouched working position. Roentgenographic examination by compensation physicians, however, does not disclose any increased incidence of sacroiliac arthritis (7).

Figures 1, 2, and 3 show three representative cases, with brief histories. Additional films were exhibited at the Thirty-fourth Annual Meeting of the Radiological Society of North America (8).

Figure 4 presents similar data for a patient in whom a biopsy of the left sacroiliac joint was done (Fig. 5). Grossly, at operation no joint space could be delineated and no cartilage was found. In the area of the joint, the bone was very vascular and had an extremely thin cortex. Microscopically in this area the bone was markedly atrophic and surrounded by much marrow. Only one questionable area of joint sur-

face was found, and in this area the bony surface was quite ragged and denuded of cartilage. The joint apparently was in the process of being completely obliterated.

All cases were analyzed as to the age of the patient, site of fracture, date of injury, immediate treatment following injury, level of cord transection with respect to both motor and sensory levels, the presence of para-osteo-arthropathies, the ambulatory status of the patient, the presence of decubiti, urinary abnormalities, causalgia, and other complications. The data for the patients with sacroiliac changes were compared with those for patients with radiographically normal sacroiliacs. Similar comparisons were made between the three groups of patients with varying degrees of sacroiliac involvement.

The age of the patients varied from twenty-two to fifty-six years in the group without sacroiliac changes and from eighteen to sixty-two in the abnormal group. There was no significant statistical difference between the two groups as to age incidence or distribution.

The length of time following injury varied from a few months to nineteen years in the group without changes and from a few months to twenty-two years in the arthropathic group. There was no correlation between the duration of the disability and the extent of the sacroiliac lesion. Several patients with injuries sustained less than a year prior to admission showed complete sacroiliac obliteration, as contrasted to the patient free of changes nineteen years after injury.

Fig. 4. Partial obliteration of both sacroiliac joints, with bony bridging bilaterally and considerable para-articular rarefaction, especially on the left.
Patient J. A., white male aged 23, sustained a fracture dislocation of T-12 on T-11 on May 9, 1944; paraplegia with motor level at L-1 and sensory level at T-12. This patient was bedridden for four years prior to admission. See also Fig. 5.

The sensory and motor levels were quite variable in both main groups of patients. No correlation could be established between the level of the central nervous system lesion and the occurrence or extent of the sacroiliac changes. Surprisingly enough, 5 patients with minimal paraplegia of the sacral cauda equina type showed extensive sacroiliac changes. Sixteen patients had causalgia of varying degree but no relationship could be established between the presence of causalgia and the presence or extent of the sacroiliac changes.

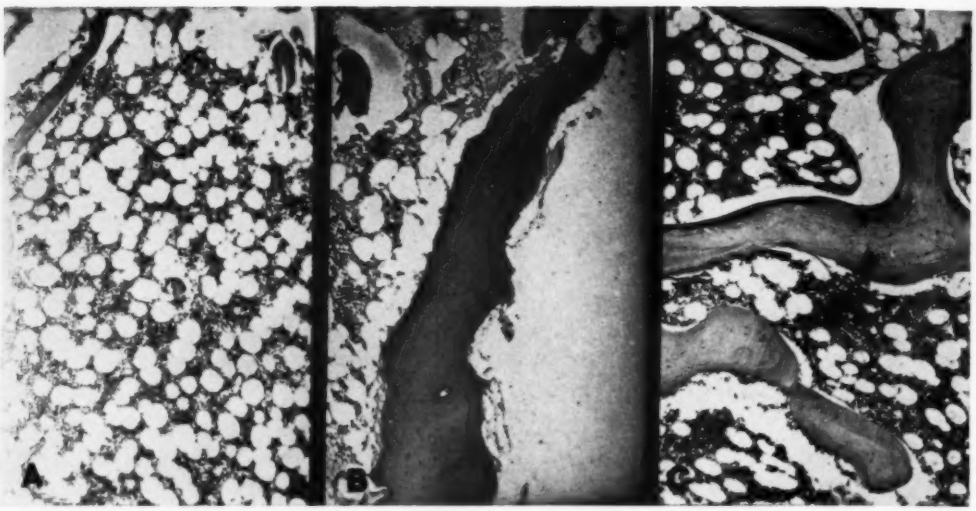

Fig. 5. Photomicrographs of sections from a biopsy of the left sacroiliac joint of patient J. A. (Fig. 4).
A. Section at joint demonstrating extremely atrophic bony trabecula surrounded by apparently normal marrow.
B. Section of residual joint surface completely denuded of cartilage.
C. Section of bone away from joint area, normal in appearance.

Para-osteo-arthropathies occurred in approximately 20 per cent of the patients without sacroiliac changes, and in 33 per cent of the other group. Similarly the latter group showed an increased incidence of decubiti and a higher percentage of patients who were completely bedridden. The difference in incidence of these findings in the two groups is interesting but by no means statistically significant. The same factors may be operative in producing the para-osteo-arthropathies and the sacroiliac joint changes, but statistical proof is lacking.

Urinary tract infection and calculi and other clinical complications were about evenly distributed in the two groups of patients, and no significant statistical correlation could be established between the joint changes and any of the clinical data.

## DISCUSSION

The lack of correlation of the sacroiliac changes with any of the factors studied leaves us only negative data from which to determine the etiology of the lesions, and any such determination is obviously largely speculation. The factors which should account for the changes, on purely *a priori* reasoning, should stem from the central nervous system lesion, the inactivity of the patient, and the profound metabolic upset which accompanies it.

The thesis that we are dealing with neurogenic joints receives no support from the data at hand, inasmuch as there is no correlation with the level of transection or the neurologic findings. The possibility that the lesions are due to vascular changes and the like, secondary to autonomic nervous system changes, cannot be entirely eliminated. One would expect, however, some correlation with the presence or absence of causalgia.

The fusion is certainly not due to inactivity alone, since there is no time interval during which it develops, nor any correlation of its presence or absence with the duration of disability. Biopsy showed no remnants of articular cartilage and no evidence of pannus formation, suggesting that the cartilage atrophied and was replaced by new bone. It is possible that such new bone formation is aided by the abnormal mobility of skeletal calcium in the chronically bedridden patient, per-

haps in combination with abnormal vascular innervation about the sacroiliacs.

Since radiographically the sacroiliac joints of our patients resemble those seen in Marie-Strümpell's disease, it is interesting to look for other similarities. Although the sacroiliacs in the latter disease have the radiographic appearance of a rheumatoid arthritis, no positive proof of rheumatoid arthritic involvement has been found to our knowledge. Biopsies reported show no pannus formation but only a degenerative process with atrophy of the cartilage. Borak (9) believed that the sacroiliac joint changes are not inflammatory but only secondary to the inflammatory lesions in the spine. He likened the process to a rapid, premature senility of the joints. Occasionally in Marie-Strümpell's spondylitis, too, the sacroiliac involvement may be extremely variable in its time of appearance and extent (10). It is possible that the factors responsible for fusion in this disease may also be operative in paraplegia.

## SUMMARY

Of a series of 160 traumatic paraplegics, 98 showed abnormalities of the sacroiliac joints radiographically, varying from paraarticular rarefaction and narrowing of the joint space to complete bony obliteration. One biopsy of a joint demonstrating moderately severe involvement showed atrophic bone with no evidence of a joint space or articular cartilage.

No statistically significant correlation could be established between the presence or extent of the joint lesions and the site of injury, level of cord transection, duration of disability, age of the patient, presence of para-osteo-arthropathies, or other clinical findings.

The lesions described are quite similar in appearance to the sacroiliac findings in Marie-Strümpell's spondylitis. It is conjectured that similar etiologic factors may be operative.

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## REFERENCES

1. DEJERINE, MME., CEILLIER, A., AND DEJERINE, YV.: Para-ostéo-arthropathies des paraplégiques par lésions médullaires. Rev. neurol. **34:** 399–407, May 1919.

2. HEILBRUN, N., AND KUHN, W. G., JR.: Erosive Bone Lesions and Soft-Tissue Ossifications Associated with Spinal Cord Injuries (Paraplegia). Radiology **48:** 579–592, June 1947.

3. ROCHE, M. B., AND JOSTES, F. A.: Ectopic Bone Deposits: A Paraplegic Complication. Am. J. Surg. **75:** 633–636, April 1948.

4. ABRAMSON, D. J., AND KAMBERG, S.: Spondylitis, Pathological Ossification and Calcification Associated with Spinal-Cord Injury. J. Bone & Joint Surg. **31-A:** 275–283, April 1949.

5. BRAILSFORD, J. F.: Pathological Changes in Bones and Joints Induced by Injury. Brit. M. J. **2:** 657–663, Oct. 3, 1936.

6. BRAILSFORD, J. F.: Changes in Bones, Joints and Soft Tissues Associated with Disease or Injury of the Central Nervous System. Brit. J. Radiol. **14:** 320–328, October 1941.

7. HARMON, P.: Personal communication.

8. ABEL, M. S., AND LOMHOFF, I. I.: Sacroiliac Changes in Traumatic Paraplegics. Exhibit at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, 1948.

9. BORAK, J.: Significance of the Sacroiliac Findings in Marie-Strümpell's Spondylitis. Radiology **47:** 128–141, August 1946.

10. BOLAND, E. W., AND SHEBESTA, E. M.: Rheumatoid Spondylitis: Correlation of Clinical and Roentgenographic Features. Radiology **47:** 551–561, December 1946.

## SUMARIO

### Alteraciones de la Articulación Sacroilíaca en la Paraplejía Traumática

De 160 parapléjicos traumáticos, 98 revelaron radiográficamente anomalías de las articulaciones sacroilíacas, variando de enrarecimiento paraarticular y estrechamiento del espacio interarticular a completa obliteración ósea. La biopsia de una articulación que mostraba invasión moderadamente grave mostró atrofia ósea sin signos de espacio interarticular o de cartílago articular.

No pudo establecerse ninguna correlación estadísticamente significativa entre la presencia o extensión de las lesiones articulares y el sitio de la lesión u otros hallazgos clínicos.

Las lesiones descritas son bastante semejantes a los hallazgos sacroilíacos en la espondilitis de Marie-Strümpell, conjeturándose que pueden intervenir factores etiológicos similares.

# Hemorrhage from a Meckel's Diverticulum as a Cause of Melena in Infancy[1]

## Report of a Case in Which the Diverticulum Was Demonstrated Roentgenographically

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IN THE DIFFERENTIAL diagnosis of melena in infancy one of the conditions to be considered is hemorrhage from a Meckel's diverticulum. In the case to be reported here, a Meckel's diverticulum was demonstrated by a preoperative roentgenogram. The diagnosis was made clinically by the pediatrician and the consulting surgeon, but roentgenograms afforded positive evidence. Surgical removal of the diverticulum resulted in a cessation of the melena.

### CASE REPORT

T. G., white male, age thirteen months, was admitted to the hospital Nov. 25, 1948, because of bloody bowel movements and intense pallor. He had been passing large amounts of fresh and clotted blood in the stools for about twelve hours prior to admission. The pertinent previous history was as follows:

The parents had first noticed blood in the stools in June 1948. Bleeding occurred on one day, followed by normal stools the next day and a recurrence of bleeding on the third day. A physician was consulted. A stool specimen at that time showed no blood. The child was not acutely ill, and because no abnormal condition was found on clinical examination, he was allowed to return home without hospitalization. In September 1948, there was a recurrence of bleeding for one day. At that time the parents noticed an increasing pallor.

On admission of the infant to the hospital, Nov. 25, 1948, the examining pediatrician (C. F. F.) noted gross blood in the stools. The child appeared acutely ill and was very pale. Examinations of the eyes, ears, nose and throat, the thorax, the genitals, and the back and extremities were normal. Abdominal examination revealed no palpable masses or areas of rigidity. Rectal examination disclosed no abnormalities, but there was blood on the examining finger. Urinary findings were negative. The blood count showed a marked secondary anemia (6.6 gm. hemoglobin, 2,760,000 erythrocytes). Repeated studies on the same day and the following morning showed elevation of the white count, ranging between 12,000 and 17,000, but the differential count was normal. The blood was type 2, and was Rh positive.

The child continued to pass bright red and dark blood in the stools, and the pediatrician considered a diagnosis of a bleeding Meckel's diverticulum most likely. Surgical consultation was obtained (W. R. L. II). It was the opinion of the surgeon, also, that a bleeding Meckel's diverticulum was the most likely diagnosis, but it was deemed advisable to examine the colon by x-ray prior to undertaking exploratory operation.

*Roentgen Examination:* Before beginning the roentgen examination, the radiologist was aware of the clinical diagnosis of probable bleeding Meckel's diverticulum. The examination was undertaken primarily to rule out two other lesions: (1) a solitary polyp or polyposis of the colon (rectal examination had failed to reveal any polyps); (2) an intussusception (clinical examination had failed to reveal any definite evidence of this lesion).

A No. 18 Bard balloon type catheter was inserted into the rectum, and the balloon portion was distended. (It is best to insert these catheters without lubricant if possible, to avoid their easy expulsion by a straining infant.) The enema was administered from a height of three feet above the table. The colon filled rapidly to the cecum. A small amount of barium was seen to enter the terminal ileum. Examination was terminated at this point, and a film exposed (Fig. 1). This phase of the examination ruled out intussusception, with the single exception of an ileal-ileal intussusception, which is very rare.

In preparation for double-contrast study of the colon, the rectal catheter was removed, and the abdomen gently massaged to aid in expulsion of the enema. After partial evacuation and prior to injecting air, another film of the abdomen was made (Fig. 2). This revealed the true condition. During evacuation, some of the barium passed into the terminal ileum by reflux through the ileocecal valve. About two inches below the level of the cecal tip, there appeared to be a tubular segment of intestine "wrapped" about the ileum. This was interpreted

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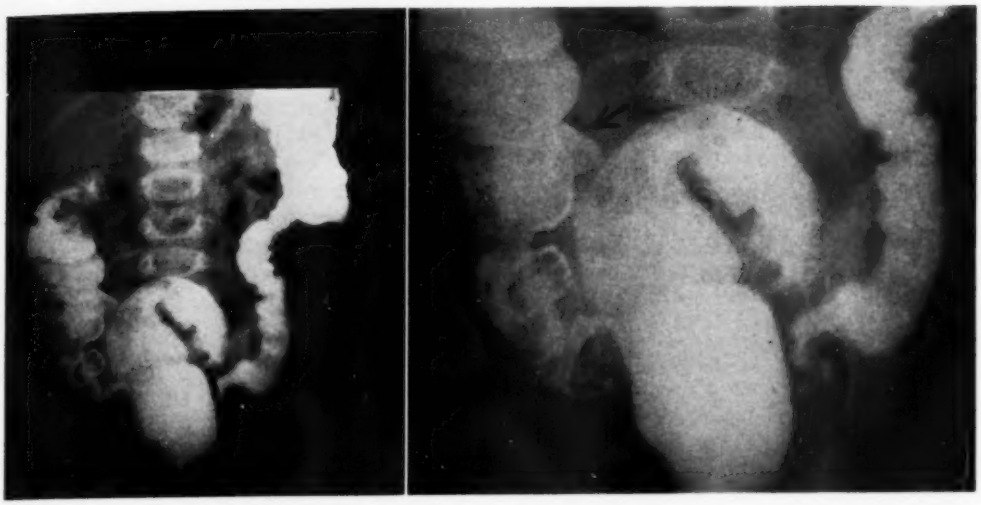

Fig. 1. Initial roentgenogram made after the colon was filled under fluoroscopic control. The view to the left shows the entire colon. On the right is an enlargement to show details of the right lower quadrant. The cecum is completely filled and there is reflux into the terminal ileum through the ileocecal valve. The terminal ileum may be seen passing cephalad before emerging from the medial aspect of the ascending colon (arrow).

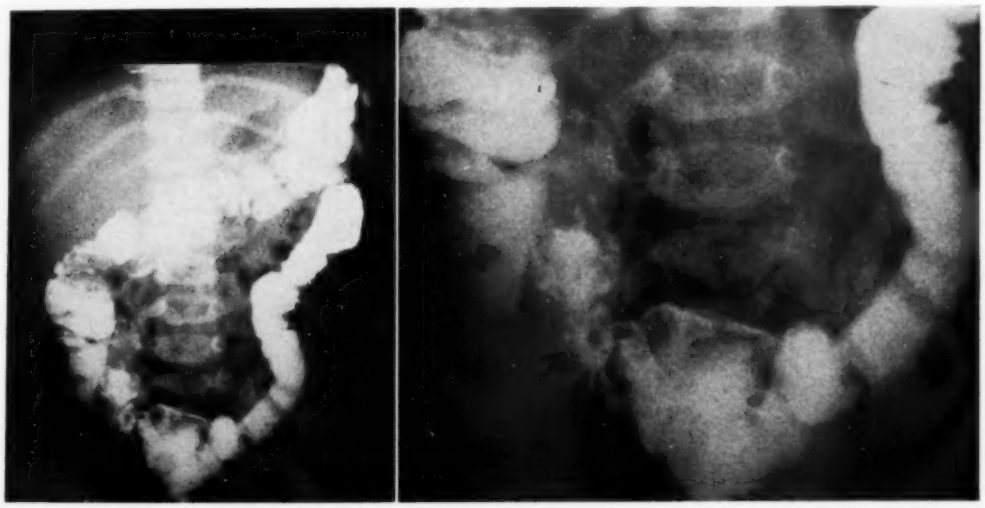

Fig. 2. Roentgenogram made after partial evacuation of the barium enema. The left-hand view shows the entire colon. To the right is an enlargement to show details of the right lower quadrant. The barium has filled the dilated terminal ileum. At the point indicated by the arrow the Meckel's diverticulum (doughnut-like in shape) is visualized. Note the small radiolucent areas within the barium-filled diverticulum.

as a Meckel's diverticulum. At the site of the diverticulum the ileum appeared narrowed, and between this point and the cecum it appeared dilated. This was undoubtedly due to the fact that the diverticulum had produced partial obstruction to the retrograde filling of the ileum through the ileocecal valve. Several small radiolucent areas were visible in the diverticulum. They were thought to represent either islands of tissue (gastric or pancreatic mucosa, as is commonly found in Meckel's diverticulum) or blood clots. The examination was terminated at this point.

After adequate preparation, consisting of blood transfusions, intravenous fluids, vitamin K, and antibiotics, exploration was undertaken (by W. R. L. II).

A primary low right rectus incision was made, and the rectus muscle was then retracted laterally before continuing the incision into the peritoneal cavity. The large intestine, the stomach, duodenum, liver, gallbladder, spleen, and pancreas were normal to palpation. Approximately 60 cm. from the ileocecal valve, on the ante-mesenteric border of the ileum, was a Meckel's diverticulum measuring 3 cm. in length and 2 cm. in diameter and containing gastric mucosa, which was superficially ulcerated and bleeding. The diverticulum was excised and the ileum was closed transversely with an inner row of 000 chromic catgut on an atraumatic needle and an outer row of interrupted sutures of 000 black silk to approximate the serosa. The ileum distal to the Meckel's diverticulum contained dark blood, which was visualized quite easily through the walls of the ileum. The peritoneum and fascia were closed with continuous 00 catgut and the skin with 0000 nylon.

Two days after surgery the stools were normal, and recovery was uneventful. There has been no recurrence of the rectal bleeding since that time.

## DISCUSSION

Meckel's diverticulum is said to be found in 1.5 to 3.0 per cent of all persons coming to autopsy. It occurs in the ileum anywhere from 25 to 100 cm. proximal to the ileocecal junction and arises from the ante-mesenteric or free border. The diverticulum varies in size from a flattened pouch in the ileal wall to a tubular structure, which may be 10 cm. or more in length and have a diameter approximately that of the ileum from which it arises.

In addition to normal intestinal mucosa, the diverticulum may contain heterotopic gastric mucosa or pancreatic tissue, or duodenal glands (Brunner's glands), either in the wall or in the form of polypoid accumulations of these tissues. The normal intestinal mucosa may occasionally give rise to polypoid masses in the diverticulum. Twenty-five per cent of all Meckel's diverticula contain heterotopic tissue, most often gastric in type. These gastric tissues are capable of secreting hydrochloric acid and pepsin, the secretion usually beginning synchronously with the gastric activity. Thus all mucosal structures in the diverticulum are exposed to these digestive juices at a time when food and intestinal juices are not present to act as buffers.

The presence of gastric mucosa is responsible for the commonest complication of Meckel's diverticulum, *i.e.*, hemorrhage. When bleeding occurs from a Meckel's diverticulum, it means peptic ulceration. This may occur in any of the tissues in the diverticulum but the most frequent site is the intestinal mucosa close to the boundary of the heterotopic gastric mucosa. The ulcers microscopically and macroscopically are similar to typical peptic ulcers of the stomach and duodenum. Severe pain usually indicates a penetrating ulcer and involvement of the parietal peritoneum. Perforation may occur.

X-ray demonstration of a Meckel's diverticulum is rare, especially in infants. If, however, special care is taken to fill and examine the distal ileum, these diverticula, both symptomatic and asymptomatic, may be demonstrated with increasing frequency.

In the case reported here, bleeding occurred from a superficial peptic ulcer in the gastric mucosa. The absence of pain is due to the fact that the ulcer did not lie close to the parietal peritoneum and was not penetrating. The radiolucent defects visualized in the diverticulum on the roentgenogram were due to blood clots, there being no polypoid elevations in the mucosa.

## SUMMARY

1. Hemorrhage from a Meckel's diverticulum is one of the causes of melena in infancy.

2. A case is reported in which the Meckel's diverticulum was demonstrated roentgenographically.

3. Surgical removal of the diverticulum resulted in cessation of the melena and complete recovery of the patient.

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## REFERENCES

1. WHEELOCK, M. C., AND TELOH, H. A.: Meckel's Diverticulum with Aberrant Pancreatic Tissue and a Polyp Containing Gastric Glands. Arch. Path. **47:** 612–617, June 1949.

2. MESSENGER, H. M., AND COLLINS, E. N.: Peptic Ulcer in Meckel's Diverticulum. Report of a Case. Cleveland Clin. Quart. **14:** 139–144, July 1947.

3. LEDOUX, ALFRED C.: Meckel's Diverticulum. Radiology **38:** 728, June 1942.

SUMARIO

**Hemorragia de un Divertículo de Meckel como Causa de Melena en la Infancia. Comunicación de un Caso en que se Demostró Radiográficamente la Presencia del Divertículo**

La hemorragia procedente de un divertículo de Meckel puede constituir una causa de melena en la infancia. En el caso comunicado se hizo el diagnóstico clínicamente y se confirmó con el hallazgo roentgenológico del divertículo, que estaba situado a unos 60 cm. de la válvula íleocecal. El mismo tenía 3 cm. de largo y 2 cm. de diámetro, conteniendo mucosa gástrica que estaba superficialmente ulcerada y sangrante. La excisión del divertículo logró el cese de la melena.

# Spontaneous Pneumaturia

## With Report of a Case[1]

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SPONTANEOUS pneumaturia is a term applied to the spontaneous appearance of gas in the bladder. We are all familiar with the appearance of an air-filled bladder because we inject air as a contrast medium. Its use alone or in combination with other contrast media is too well known to require discussion in this paper. The spontaneous appearance of air in the bladder, however, is rare. About 30 cases have been recorded in the literature, most of these in autopsy reports. Only 5 cases have appeared in the American literature. In a review of the last 200 intravenous pyelograms done at the Oil City and Franklin Hospitals, we were unable to find a single instance of air in the bladder.

Pneumaturia may occur in several different ways: first, as a result of injection of air for diagnostic purposes, as mentioned above, or by its accidental injection during cystoscopy; second, by introduction of air through a puncture wound of the bladder or an operative procedure; third, as a result of a vesico-vaginal or vesico-intestinal fistula, which may be due to an anomaly, infection, or neoplasm; fourth, by manufacture of gas in the bladder itself.

There are apparently several different ways in which gas can be produced in the bladder. It may occur in the mucosa in small blebs, ranging in size from that of a pinhead to a pea. These may cover a part or all of the bladder and, when rupturing, release gas. On cystoscopy, the bladder wall presents a silvery appearance, and one can actually observe the rupture of these vesicles. Microscopically, these air cysts are either lined with endothelial cells and multinuclear giant cells derived from the endothelium or they have no cellular lining at all and are surrounded by several layers of homogeneous fibers. The first type of cyst probably represents lymphatic distention; the other type is merely an enlarged tissue space. There are on record cases in which gas was produced in a diverticulum of the bladder. One author described gas coming from a ureteral opening and disappearing after nephrotomy.

Gas, whether formed in blebs in the mucosa or in the urine itself, is probably due to the presence of gas-forming bacteria. Bacteria have been found in the mucosa in all cases examined postmortem with a single exception, but the type of organism is not constant. The most common is the colon bacillus; others are *Bacillus lactis aerogenes*, *Bacillus aerogenes capsulatus*, and yeast. Certain strains of bacteria are able to form gas from sugar, and a high percentage of the recorded cases of pneumaturia have been in diabetics. Taussig reported a case in which colon bacilli were found that were able to produce gas in the presence of sugar, but after several generations apparently lost this power. On analysis, the gas has always been found to be carbon dioxide. In cases without glycosuria, it is possible that the urine contains some type of albuminose protein capable of forming gas when the strain of bacteria in the bladder has gas-producing powers. Mulsow and Gillies stated that acid urine coming from the kidneys and acting on the carbonates in the urine of the bladder may produce gas.

In almost all cases of pneumaturia urinary retention has been considered as an etiologic factor. This may be due to polyneuritis, which is fairly common in diabetics. Cord changes, stricture of the urethra, and, in males, an enlarged prostate may also cause retention.

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Fig. 1. Anteroposterior view showing large gas-filled bladder.

Fig. 2. Lateral view showing oval area of decreased density which proved to be gas in the bladder.

The patients have ranged in age from thirty-four to seventy-six, most of them having been in their sixties. According to Ravich and Katzen, the disease is far more common in females than males; they found in the literature 24 cases in females and 5 in males.

Because of the small number of cases, the question of treatment for this condition has not been placed on a very definite basis. Operation was done in one case and a drainage tube was put in the bladder. The patient survived the operation and apparently had no further trouble. Arthur and Johnson gave their patient 2 gm. of calcium mandelate q. i. d., which caused the symptoms to subside. They believe that pneumaturia is of little consequence in so far as the patient's welfare is concerned, and they intimate that if the residual urine can be eliminated and suitable urinary antiseptics given, the condition will eventually clear itself, although the presence of diabetes constitutes an additional complication.

According to Hueper, pneumaturia is much more common in animals than man. He states that a similar condition may be found in the intestinal and vaginal mucosa of animals.

## CASE REPORT

A woman of 62 years first entered the hospital on June 11, 1948. She was known to have had diabetes for about seven years, but had made little or no effort to control the disease. Her chief complaint was weakness and irritation of the bladder. The physical examination revealed a rather tender abdomen and an enlarged liver, but no mention is made in the case record of a mass in the lower abdomen. The laboratory report showed blood culture to be positive for the colon bacillus. A diagnosis of diabetes mellitus cystitis was made and daily irrigation of the bladder with 5 per cent argyrol was instituted. The patient was placed on a diet and insulin, which satisfactorily controlled the diabetes, and she was discharged on July 8. During her stay at the hospital, she had a number of attacks of diarrhea and upon several occasions was unable to void.

The next admission was on July 28, when the patient complained of generalized weakness and bloating. She had not taken care of her diabetic condition too well, and her urine showed a large amount of sugar. Because of the bloating, anteroposterior and

lateral films of the abdomen (Figs. 1 and 2) were taken, revealing a pear-shaped mass of decreased density reaching above the umbilicus. This was interpreted as an air-filled bladder. The patient was catheterized while on the x-ray table and about 1,000 c.c. of a brownish-colored urine was obtained. During the catheterization, a large amount of gas was expelled from the catheter. A film taken after catheterization showed that almost all of the gas had disappeared.

The patient's attending physician put her on urinary antiseptics, and she was catheterized every eight hours, but she responded poorly. Large amounts of gas were obtained on catheterization, and her troubles were increased by an obstinate constipation. The diabetes was controlled with difficulty and gangrene developed in the right foot, which, because of the poor physical condition, could not be amputated. The patient decided to leave the hospital, and at home the gangrene became more extensive. Catheterization was continued at eight-hour intervals, yielding large amounts of air from the bladder. Death occurred in February 1949, from diabetes and gangrene.

It is our opinion that pneumaturia is much more common than is generally realized. Small amounts of air could easily occur in the bladder and be mistaken for air in the sigmoid. As pneumaturia is much more common in diabetes, the presence of air in the bladder should always be kept in mind in such cases.

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## REFERENCES

ARTHUR, L. M., AND JOHNSON, H. W.: Pneumaturia. A Case Report and Review of the Literature. J. Urol. **60:** 659–665, October 1948.

BURRELL, N. L.: Cystitis Emphysematosa. Case Report and Review of the Literature. J. Urol. **36:** 690–693, December 1936.

HUEPER, W.: Cystitis Emphysematosa. Am. J. Path. **2:** 159–165, March 1926.

LEVIN, H. A.: Gas Cysts of the Urinary Bladder. J. Urol. **39:** 45–52, January 1938.

LUND, H. G., ZINGALE, F. G., AND O'DOWD, J. A.: Cystitis Emphysematosa. Report of Case Found at Cystoscopy and Followed by Recovery. J. Urol. **42:** 684–688, November 1939.

MARQUARDT, C. R.: Cystitis Emphysematosa. Urol. & Cutan. Rev. **44:** 295–296, May 1940.

MILLS, R. G.: Cystitis Emphysematosa. Report of a Series of Cases in Women. J. A. M. A. **94:** 321–326, Feb. 1, 1930.

MILLS, R. G.: Cystitis Emphysematosa. Report of Cases in Men. J. Urol. **23:** 289–306, March 1930.

RAVICH, A., AND KATZEN, P.: Cystitis Emphysematosa. Review of the Literature with Report of Authentic Case Terminating in Recovery. J. A. M. A. **98:** 1256–1259, April 9, 1932.

WILHELM, S. F.: Cystitis Emphysematosa Treated with Sulfanilamide. New York State J. Med. **39:** 2054–2056, Nov. 1, 1939.

## SUMARIO

### Neumaturia Espontánea, con Presentación de un Caso

La neumaturia espontánea, es decir, la aparición espontánea de gas en la vejiga urinaria, parece ser rara, habiéndose anotado solamente unos 30 casos en la literatura. Pasa por ser debida a la presencia de bacterias aerógenas, pues ciertas cepas bacterianas pueden formar gas del azúcar, y un elevado porcentaje de los casos descritos han ocurrido en diabéticos. La retención urinaria pasa por tener importancia etiológica.

En el enfermo del A. se sabía que había habido diabetes, mal cohibida, durante siete años. La vejiga, llena de aire, fué observada roentgenográficamente, y el cateterismo rindió 1,000 cc. de orina y grandes cantidades de gas. Administráronse antisépticos urinarios, pero la respuesta fué mala, y continuó obteniéndose gas en los cateterismos repetidos. La muerte se debió a diabetes y gangrena asociada del pie.

Señálase que sería fácil tomar la presencia de aire en la vejiga por aire en la S ilíaca. Hay que tener presente el estado, sobre todo en los diabéticos.

# Aneurysm of the Pulmonary Artery

## A Case Diagnosed by Angiocardiography[1]

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ANGIOCARDIOGRAPHY has become an established procedure enhancing the diagnostic possibilities of radiology. This is particularly true in relation to aneurysms of the pulmonary artery, which heretofore were usually diagnosed at operation or postmortem. The differential diagnosis of hilar lesions and lesions in the vicinity of the hilus is at times impossible unless angiocardiography is done. By adequate angiocardiograms aneurysms of the main pulmonary artery or its subdivisions can now be distinguished with considerable certainty from a non-vascular mass with transmitted pulsation (11).

Since aneurysms of the pulmonary artery are rare, and since the radiologic literature contains records of surprisingly few cases diagnosed in the living patient, we are presenting a report of a left pulmonary artery aneurysm together with a brief review of earlier publications on this subject.

### INCIDENCE

Deterling and Clagett (3) reviewed several autopsy series reported from various sources between 1848 and 1946, totaling 109,571 cases, in which only 8 pulmonary artery aneurysms were found. These same authors reviewed reports of a total of 4,126 intrathoracic aneurysms recorded in the literature between 1785 and 1946 and found records of only 6 involving the pulmonary artery. Their collected series of proved cases, including one of their own, numbered 36. Boyd and McGavack (1), covering the literature from 1833 to 1939, collected a total of 111 cases of pulmonary artery aneurysms proved at autopsy, of which only 28 were diagnosed antemortem. A total of 147 proved cases had been recorded up to September 1946.

### ETIOLOGY

The etiology of pulmonary artery aneurysm is varied.

1. *Syphilis:* In 1917, Warthin (20) stated that all pulmonary artery aneurysms were due to syphilis. Upon the basis of subsequent reports of proved cases, this opinion must be revised; it would be more correct to place the incidence of syphilitic aneurysms at about 33 per cent of the total. Boyd and McGavack found the incidence in their series to be 31.7 per cent, while Deterling and Clagett reported 39 per cent.

2. *Congenital Defects:* Congenital anomalies were associated with 66 per cent of the cases collected by Boyd and McGavack, and with 43.2 per cent of the series of Deterling and Clagett. Forty-seven per cent of all pulmonary artery aneurysms were attributed directly to the anomalies.

To date almost every type of known cardiovascular anomaly has been reported to be associated with pulmonary artery aneurysm. Of these, patent ductus arteriosus is by far the most common, occurring in 21 to 23 per cent of all cases (1, 3).

3. *Pulmonary Arteriosclerosis (Atheroma):* Boyd and McGavack found atheroma to be the etiologic factor for aneurysmal dilatation of the pulmonary artery in 23 per cent of their series, and Deterling and Clagett in 30 per cent of theirs. In the latter series, 3 cases were associated with markedly sclerotic vessels in both

[1] From the Department of Radiology, Lawson Veterans Administration Hospital, Chamblee, Ga., and Emory University School of Medicine, Atlanta, Ga. Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors.

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lungs. Several patients had atheromatous changes within the aneurysm in addition to septal defect or patent ductus arteriosus.

4. *Infections Other than Syphilis:* Mycotic aneurysms of the pulmonary artery have been noted in several cases. The vegetation may have its origin on an old rheumatic pulmonary valvular lesion or on a congenital anomaly such as patent ductus arteriosus. Hartwell and Tilden (7) described the development of pulmonary artery aneurysm in a 12-year-old girl who had a patent ductus arteriosus and who subsequently had a subacute bacterial endocarditis. Boyd and McGavack noted 7 cases arising from rheumatic endocarditis, 6 cases from septic endocarditis, and 5 with infection developing on the basis of a congenital anomaly. Four cases of Deterling and Clagett followed subacute bacterial endocarditis. Touroff and Vesell (19) demonstrated, first at operation and subsequently at autopsy, the coexistence of dilatation of the pulmonary artery with mural vegetation in cases of patent ductus arteriosus with bacterial endocarditis.

5. *Trauma:* Injury rarely is the cause of pulmonary artery aneurysms; only 3 cases have been reported to date.

## AGE AND SEX INCIDENCE

Pulmonary artery aneurysm occurs predominantly in a younger age group than aortic aneurysms. In reported cases the range is from four to eighty-two years, with a mean age for all cases of thirty-eight years. Boyd and McGavack reported an incidence of 34 per cent of pulmonary artery aneurysms before the age of thirty, 38 per cent between thirty and sixty, and the remainder after sixty; for aortic aneurysms the figures for the three age groups were 16 per cent, 63 per cent, and 21 per cent, respectively. The relatively more frequent congenital etiology of pulmonary artery aneurysms readily explains this age difference.

Pulmonary artery aneurysms are equally distributed between the sexes, as contrasted to aortic aneurysms, of which 88 per cent occur in males (1, 3).

## LOCATION AND ANATOMICAL TYPE

Costa (2) has stated that the aneurysm involves the main trunk of the pulmonary artery in 85 per cent of the cases, and that the major branches alone are involved in only 15 per cent. In the series of Boyd and McGavack, comprising 111 autopsy cases, 75 involved the trunk alone, 9 the trunk and both branches, and 5 the trunk and left branch. Both branches were involved in 3 cases, the right branch alone in 9 cases, the left alone in 10 cases. Of Deterling and Clagett's series, 89 per cent involved the main trunk alone or were associated with aneurysm of a major branch; in 8 per cent the right artery alone and in 3 per cent the left only was affected.

Of the 75 cases reported by Boyd and McGavack involving the trunk of the pulmonary artery, 36 were fusiform and 41 saccular. Deterling and Clagett reported 24 fusiform and 12 saccular aneurysms of the trunk. The aneurysms of the branches may be either type, more often being saccular (1).

Single aneurysm is the rule, although multiple aneurysms have been noted. Recorded aneurysms have varied from 3 to 15 cm. in diameter. Lamillated clots may completely occlude the lumen of the aneurysm and may obliterate its pulsations (21).

## ASSOCIATED CARDIOVASCULAR CHANGES

Cardiac enlargement depends on the existence of pulmonary hypertension or cardiac decompensation. Deterling and Clagett noted cardiac enlargement in 31 of their cases, 70 per cent right-sided, 25 per cent generalized, and 5 per cent left-sided. Dilatation of the right or left ventricle is more common than hypertrophy. Of all cases in which electrocardiography was done, 75 per cent showed right axis deviation.

## SYMPTOMS AND SIGNS

Diagnosis of pulmonary artery aneurysm by clinical signs only, without x-ray studies, is impossible. In the largest series of cases reported to date (1, 3), various cardiorespiratory symptoms have been noted,

none being pathognomonic. Cough has been recorded as being present in 78.8 per cent of all cases, dyspnea in 76.6 per cent, anterior chest pain in 60.3 per cent, cyanosis in 50.8 per cent, and palpitation in 23 per cent. Hemoptysis has been noted frequently (21, 1, 3). Yuskis (21) reported the case of a 21-year-old white girl with repeated severe hemoptysis, who eventually died because of rupture of the aneurysm into the right bronchus.

Physical signs are varied and, again, are not diagnostic. Percussion may reveal enlargement of cardiac contours. Exaggerated pulsations over the pulmonic area have been reported in 64.5 per cent of clinically observed patients having pulmonary aneurysms (1); a systolic thrill was noted in 58.3 per cent, a diastolic thrill in 6.2 per cent. A systolic murmur over the left second and third intercostal space anteriorly was reported in 83 per cent. Large aneurysms may occasionally cause a bulge of the chest wall to the left of the sternum.

### COURSE

The course of pulmonary artery aneurysm is variable, depending upon the type of congenital lesion, if one is present, the onset of cardiac decompensation, the development of bacterial endocarditis, or the rupture of the aneurysm into a bronchus, the pericardium, or the pleural cavity, with sudden death.

### ROENTGEN DIAGNOSIS

Roentgen findings depend on the location of the aneurysm. Involvement of the main trunk of the pulmonary artery will produce in the postero-anterior view a convex homogeneous increased density overlying the pulmonary artery area. This same expansion of the main artery will be noted on both oblique projections. Aneurysms of the right or left major branches usually produce uniform rounded increased densities overlying either hilus on the postero-anterior roentgenogram, identifiable also in either oblique projection. Expansile pulsations of the mass are usually seen fluoroscopically or by roentgen kymographic study unless obliterated by the existence of a lamillated clot (21). These examinations are suggestive but are not diagnostic because of the possibility of transmitted pulsations.

Angiocardiography provides the only accurate means for diagnosing a pulmonary artery aneurysm before operation or autopsy. This procedure will establish the vascular nature of the lesion, identify it with the pulmonary artery, and demonstrate its aneurysmal character—fusiform or saccular. Other cardiovascular lesions (anomalies, etc.) can be found if present.

The etiology of the pulmonary artery aneurysm must still be determined at operation or postmortem, although clinical studies may be suggestive.

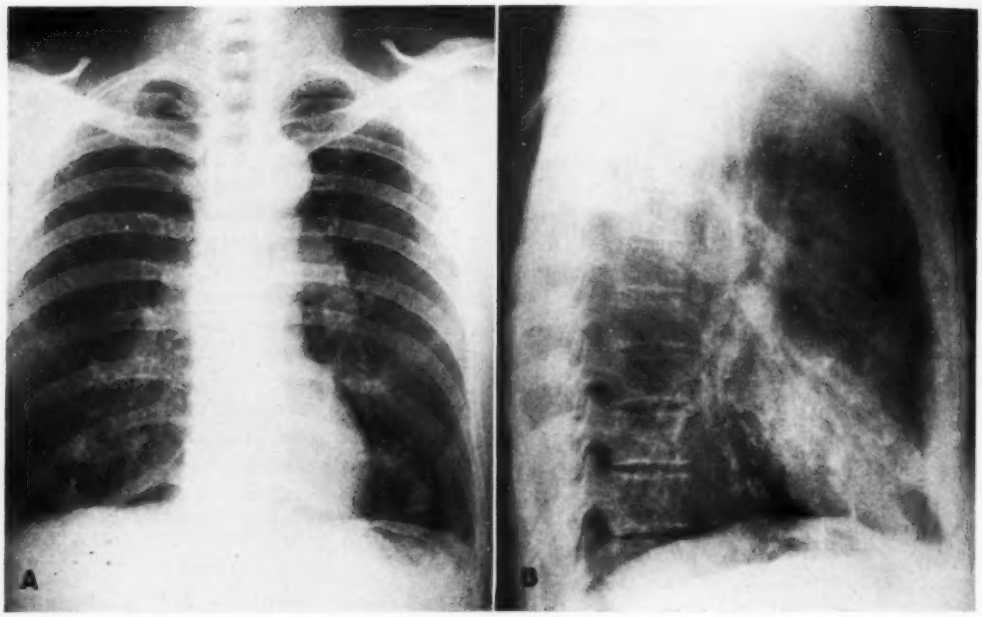
### CASES FROM THE LITERATURE DIAGNOSED BY ANGIOCARDIOGRAPHY

Robb and Steinberg (11, 9) found 2 examples of dilated pulmonary artery thought to be due to aneurysm in their series of 233 cases. Boyd and McGavack (1) and Sussman (16) each reported one aneurysm diagnosed by angiocardiography. Dilatation of the entire pulmonary artery, not attributable to aneurysm, was reported by Taylor and McGovern (17) in one case; by Grishman, Steinberg, and Oppenheimer (5) in 4 cases believed to be of congenital origin. Stewart, Breimer and Maier (15) demonstrated an irregularly dilated pulmonary artery in one patient. One case of pulmonary artery dilatation associated with cor pulmonale was reported by Robb and Steinberg (10). Steinberg, Grishman and Sussman (13) have shown pulmonary artery dilatation associated with intracardiac shunts.

### DIFFERENTIAL DIAGNOSIS

A differential diagnosis must be made between vascular and non-vascular lesions:

I. *Non-vascular Lesions:* (1) *Lung tumors*, sharply circumscribed without accompanying atelectasis or other complicating features, are most often confused with aneurysms of the left or right pulmonary artery. Expansile pulsations of the lesion



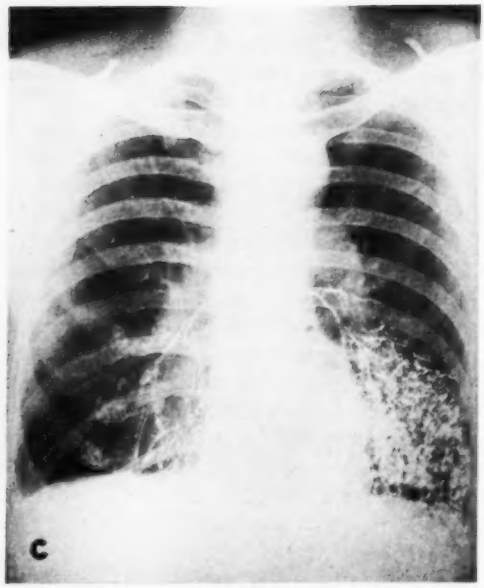




Fig. 1. A. Postero-anterior roentgenogram, showing a well circumscribed oval mass measuring 4 cm. in diameter overlying the left hilus. Vascular markings of the lungs are normal. Fluoroscopically, marked intrinsic pulsations were noted.

B. Left lateral roentgenogram, showing rounded density overlying the pulmonary artery area.

C. Bronchogram. The oval density in the left hilus does not distort but lies contiguous to the main left bronchus.

would favor aneurysm. This was the situation in the case to be reported here. Oblique and lateral views of the chest will differentiate all lesions not superimposed on pulmonary artery shadows; however, only angiocardiography will differentiate those lesions overlying the pulmonary artery in the oblique views. Thompson (18) reported the opposite situation, a diagnosis of pulmonary artery aneurysm being made after fluoroscopic study, while angiocardiography showed a normal vessel.

(2) *Tumors of the mediastinum* overlying the hilus are commonly confused with aneurysm of the main pulmonary artery trunk (16).

II. *Vascular Lesions:* (1) *Aortic aneurysm* has frequently been confused with aneurysm of the pulmonary artery (18, 16, 11, 12).

(2) Dilatation of the pulmonary artery in rheumatic mitral valvular disease, in pulmonary hypertension secondary to lung disease, in Eisenmenger's complex, in interventricular and interatrial septal defects, in Lutembacher's syndrome, in patent ductus arteriosus, and in congenital dilatations must be differentiated from

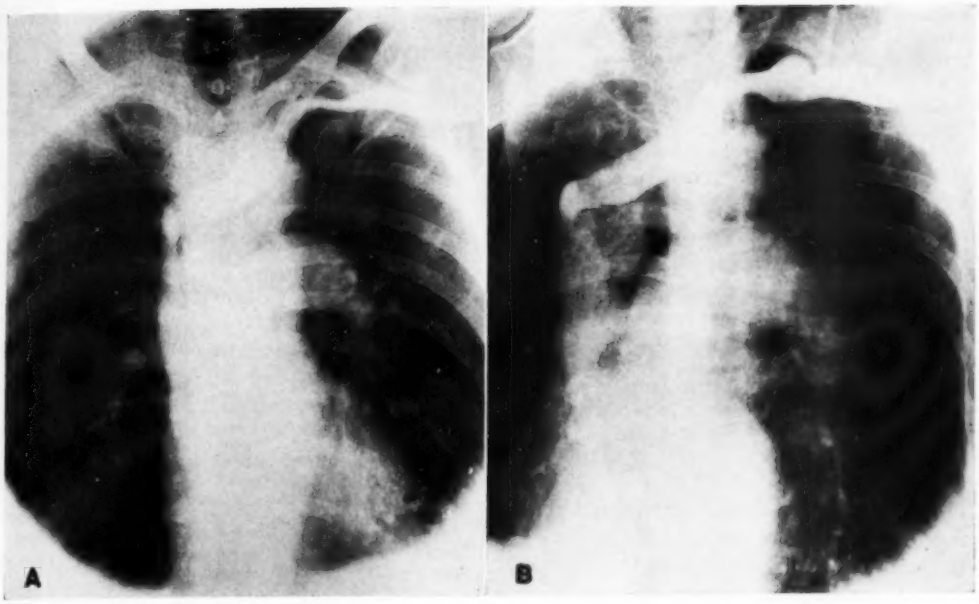



Fig. 2. A. Angiocardiogram, antero-posterior projection. The oval density of the left hilus is shown to be a fusiform left pulmonary artery aneurysm. The right pulmonary artery is normal, as are the other smaller branches of the pulmonary arterial tree.

B. Angiocardiogram, left anterior oblique, showing slight dilatation of the main trunk of the pulmonary artery in addition to the fusiform aneurysm of the left main pulmonary artery.

aneurysms. In all these conditions there is uniform dilatation commencing at the pulmonary conus and gradually fading as the pulmonary periphery is approached.

A calcified non-expansile density over the hilus must be differentiated from the following conditions (3): tuberculoma, abscess associated with Pott's disease, hilar nodes resulting from tuberculosis, histoplasmosis, or silicosis, dermoids, and substernal goiter.

In the absence of pulsation and calcification, pulmonary artery aneurysm may simulate (3): carcinoma of the lung, adenoma of the lung, mediastinal abscess, hilar lymph nodes, lymphosarcoma, thymoma, cysts of the lung and mediastinum or of the pericardium.

## CASE HISTORY

A 61-year-old white male was transferred to the Lawson Veterans Administration Hospital on March 15, 1949, for investigation of a sharply delineated uniform area of increased density overlying the left hilus. The lesion had been discovered during a routine chest x-ray examination at another hospital while the patient was being prepared for surgical repair of an inguinal hernia. There was no history of recent respiratory complaints.

Pertinent findings in the *past history* were: hypertension since 1931, a right inguinal hernia since June 1948, and mild exertional dyspnea during the past ten years. There was no history of congestive failure or chest pain. Syphilis was denied. There had been no significant childhood or adult illnesses except pneumonia in 1900.

On *physical examination* the patient appeared well developed and well nourished, and younger than the stated age of sixty-one years. The pupils reacted normally to light and accommodation. Blood pressure was 160/90. A soft systolic murmur was heard at the cardiac apex. No other abnormalities of the chest were noted. There was a small direct right inguinal hernia. Reflexes were normal. The peripheral arteries were thickened.

*Laboratory studies* were non-contributory except for the electrocardiogram, which showed left axis deviation with no other abnormalities. The Kahn test was negative.

The *clinical impression* was possible lung tumor.

*X-ray examination* of the chest in postero-anterior projection demonstrated a sharply circumscribed area of increased density, 4 cm. in diameter, overlying the left hilus (Fig. 1A). The left anterior oblique view clearly outlined a uniform area of increased density, of oval shape, along the course of the left

pulmonary artery. The subdivisions of the artery were not dilated. The entire right pulmonary artery was of normal size. The cardiac configuration showed left ventricular hypertrophy.

*Bronchography* adequately outlined the left main bronchus, delineating the area of increased density lying immediately contiguous to the superior wall of this bronchus (Fig. 1C). No extrinsic pressure defects were produced upon the left main bronchus.

*Fluoroscopy* demonstrated definite and marked intrinsic pulsations of the area of increased density in phase with the pulsations of the main pulmonary artery. An impression of left pulmonary artery aneurysm was obtained.

*Angiocardiography* confirmed the existence of an oval-shaped aneurysm and dilatation of the proximal portion of the left pulmonary artery, with slight but uniform dilatation of the proximal portion of the main pulmonary artery (Fig. 2, A and B).

## DISCUSSION

The etiology of the aneurysm in the case reported here is speculative. No congenital anomalies of the heart or the vessels at the cardiac base were demonstrated. There was no history of trauma or syphilis. There was no history of infection. Absence of precordial murmurs tends to exclude patent ductus arteriosus. The possibility of an arteriosclerotic etiology is presumed but unproved, since operation was not considered to be indicated. The history of hypertension, the mild tortuosity of the aorta, and the calcified aorta and peripheral vessels would support this etiology.

## SUMMARY

A case of left pulmonary artery aneurysm probably due to arteriosclerosis is presented, together with a review of the literature. The value of angiocardiography in evaluating the etiology and in the differential diagnosis of aneurysms of the pulmonary artery is stressed.

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## REFERENCES

1. BOYD, L. J., AND MCGAVACK, T. H.: Aneurysm of the Pulmonary Artery: A Review of the Literature and Report of Two New Cases. Am. Heart J. **18:** 562–578, November 1939.

2. COSTA, A.: Quoted by Boyd and McGavack (1).

3. DETERLING, R. A., JR., AND CLAGETT, O. T.: Aneurysm of the Pulmonary Artery: Review of the Literature and Report of a Case. Am. Heart J. **34:** 471–499, October 1947.

4. DONOVAN, M. S., NEUHAUSER, E. B. D., AND SOSMAN, M. C.: Roentgen Signs of Patent Ductus Arteriosus: Summary of 50 Surgically Verified Cases. Am. J. Roentgenol. **50:** 293–305, September 1943.

5. GRISHMAN, A., STEINBERG, M. F., AND OPPENHEIMER, B. S.: Clinical Diagnosis of Idiopathic Dilatation of the Pulmonary Artery. J. Mt. Sinai Hosp. **10:** 142–149, May-June 1943.

6. GRISHMAN, A., SUSSMAN, M. L., AND STEINBERG, M. F.: Angiocardiographic Analysis of Cardiac Configuration in Rheumatic Mitral Disease. Am. J. Roentgenol. **51:** 33–43, January 1944.

7. HARTWELL, A. S., AND TILDEN, I. L.: Aneurysm of the Pulmonary Artery. Report of a Case in Which Aneurysm Apparently Developed Under Observation. Am. Heart J. **26:** 692–698, November 1943.

8. OPPENHEIMER, B. S.: Idiopathic Dilatation of the Pulmonary Artery. Tr. A. Am. Physicians **48:** 290–297, 1933.

9. ROBB, G. P., AND STEINBERG, I.: Visualization of the Chambers of the Heart, Pulmonary Circulation, and Great Blood Vessels in Man. Am. J. Roentgenol. **41:** 1–17, January 1939.

10. ROBB, G. P., AND STEINBERG, I.: Visualization of the Chambers of the Heart and Thoracic Vessels in Pulmonary Heart Disease. A Case Study. Ann. Int. Med. **13:** 12–45, July 1939.

11. ROBB, G. P., AND STEINBERG, I.: Visualization of the Chambers of the Heart, Pulmonary Circulation and Great Vessels in Man: Summary of Method and Results. J. A. M. A. **114:** 474–480, Feb. 10, 1940.

12. ROBB, G. P., AND STEINBERG, I.: Visualization of Chambers of Heart, Pulmonary Circulation and Great Blood Vessels in Heart Disease: Preliminary Observation. Am. J. Roentgenol. **42:** 14–36, July 1939.

13. STEINBERG, M. F., GRISHMAN, A., AND SUSSMAN, M. L.: Angiocardiography in Congenital Heart Disease: Intracardiac Shunts. Am. J. Roentgenol. **49:** 766–776, June 1943.

14. STEINBERG, M. F., GRISHMAN, A., AND SUSSMAN, M. L.: Angiocardiography in Congenital Heart Disease: Patent Ductus Arteriosus. Am. J. Roentgenol. **50:** 306–315, September 1943.

15. STEWART, W. H., BREIMER, C. W., AND MAIER, H. C.: Cineroentgenographic Diagnosis of Congenital and Acquired Heart Disease. Am. J. Roentgenol. **46:** 636–640, November 1941.

16. SUSSMAN, M. L.: Differentiation of Mediastinal Tumor and Aneurysm by Angiocardiography. Am. J. Roentgenol. **58:** 584–589, November 1947.

17. TAYLOR, H. K., AND MCGOVERN, T.: Evaluation of Angiocardiography. J. A. M. A. **121:** 1270–1276, April 17, 1943.

18. THOMPSON, S. A.: Differential Diagnosis by Means of Intravenous Contrast Medium of Two Cases Simulating Aneurysm of the Pulmonary Artery. Am. J. Roentgenol. **46:** 646–649, November 1941.

19. TOUROFF, A. S. W., AND VESELL, H.: Experiences in Surgical Treatment of Subacute Streptococcus Viridans Endarteritis Complicating Patent Ductus Arteriosus. J. Thoracic Surg. **10:** 59–83, October 1940.

20. WARTHIN, A. S.: Syphilis of the Pulmonary Artery. Am. J. Syph. **1:** 693–711, October 1917.

21. YUSKIS, A. S.: Aneurysm of the Right Pulmonary Artery with Rupture into Bronchus and Patent Ductus Arteriosus. Report of a Case. California & West. Med. **58:** 272–275, May 1943.

SUMARIO

**Aneurisma de la Arteria Pulmonar: Caso Diagnosticado por la Angiocardiografía**

Este repaso de la literatura relativa al aneurisma de la arteria pulmonar va acompañado de la presentación de un caso diagnosticado con la angiocardiografía. La etiología no era clara. No se descubrieron anomalías congénitas del corazón o los vasos; no había historia de traumatismo, sífilis u otra infección; y la ausencia de soplos precordiales tendió a excluir la permeabilidad del conducto arterioso. Se supone que la etiología fué arteriosclerótica vistos los antecedentes de hipertensión, leve tortuosidad de la aorta y calcificación de la aorta y vasos periféricos.

Las radiografías revelaron una zona de condensación, netamente circunscrita, sobrepuesta al hilio izquierdo; la roentgenoscopia mostró pulsaciones en fase con las de la arteria pulmonar mayor; y la angiocardiografía confirmó el diagnóstico de aneurisma de la arteria pulmonar izquierda. Recálcase el valor de este último procedimiento para comprobar la etiología y determinar el diagnóstico diferencial.

# Carcinoma Associated with Diaphragmatic Herniation of the Stomach[1]

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REVIEW OF THE literature reveals 35 examples of carcinoma associated with diaphragmatic hernia of the stomach (Table I). Unfortunately, for the most part, the cases are not described in detail and in some instances are mentioned merely in passing. For this reason, it appears impossible to construct a clinical picture which would suggest carcinoma complicating diaphragmatic hernia. The use of supplementary procedures, however, such as esophagoscopy (16, 23), gastroscopy (13), and roentgen examination of the gastro-intestinal tract in patients with gastric herniation, particularly those exhibiting hematemesis, melena, or dysphagia, will usually establish the diagnosis.

Fig. 1. Roentgenogram showing filling defect in herniated portion of the stomach.

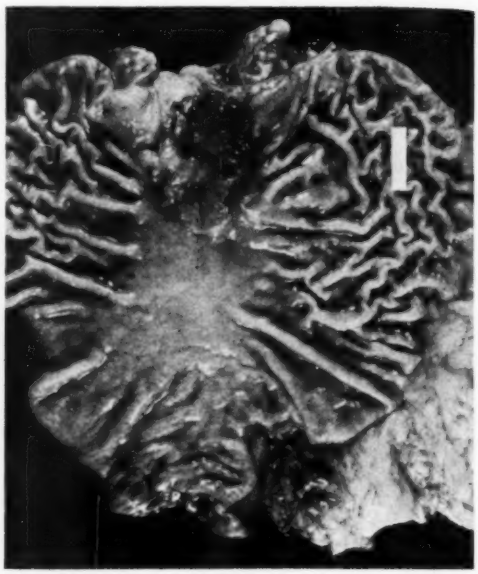

Fig. 2. Opened stomach showing ulcerated fungating carcinomatous mass at the esophagogastric area.

The case to be presented in this paper exhibited the symptomatology usually associated with advanced gastric hiatal hernia. Only after roentgen examination was the true situation revealed.

## CASE REPORT

A 63-year-old white male was admitted to the University Hospital on April 27, 1949, in a state of shock resulting from massive hematemesis. His red blood count on admission was 2.41 million and the hemoglobin level was 7.9 gm. After he had been treated for shock by multiple blood transfusions and other supportive measures, it was learned that he had been suffering for six months from epigastric distress following meals. He had had occasional episodes of melena and hematemesis in the past year and symptoms of angina pectoris for several years.

[1] From the Department of Radiology, University Hospital, New York University-Bellevue Medical Center, New York, N.Y. Accepted for publication in October 1949.

TABLE I: REPORTED CASES OF CARCINOMA ASSOCIATED WITH DIAPHRAGMATIC HERNIATION OF THE STOMACH

| Author | Year | Cases | Remarks |
|---|---|---|---|
| **Carcinoma of the Esophagus Associated with Diaphragmatic Hernia** | | | |
| Hill (1) | 1870 | 1 | Carcinoma of esophagus with hiatus hernia |
| Wolf (9) | 1928 | 1 | Carcinoma of esophagus with hiatus hernia |
| Smithers (20) | 1945 | 1 | Carcinoma of esophagus with thoracic stomach |
| Olsen and Harrington (23) | 1948 | 1 | Squamous-cell carcinoma of esophagus with thoracic stomach |
| **Carcinoma of the Stomach Herniated Through the Esophageal Hiatus** | | | |
| Eppinger (2) | 1911 | 1 | Malignant ulcer of stomach in hiatus hernia |
| Versé (4) | 1912 | 1 | Hiatus hernia containing stomach diffusely infiltrated with cancer |
| Bársony and Polgár (7) | 1928 | 1 | Carcinoma of cardia and lower portion of esophagus in hiatus hernia |
| Möller (10) | 1931 | 1 | Adenocarcinoma of fundus in hiatus hernia |
| Unger and Poppel (12) | 1937 | 1 | Carcinoma of gastric cardia herniated into left chest |
| Jacobs (14) | 1938 | 1 | Adenocarcinoma of cardia herniated through diaphragm |
| Jankelson and Morein (15) | 1940 | 2 | Carcinoma of stomach herniated through diaphragm |
| Holland and Logan (17) | 1940 | 1 | Carcinoma developing in ulcerated herniated portion of stomach |
| Smithers (20) | 1945 | 1 | A patient of Mr. Cecil Rowntree, seen in 1937, who had adenocarcinoma of lesser curvature of stomach in hiatus hernia |
| **Carcinoma of the Thoracic Stomach** | | | |
| Raven (18) | 1941 | 1 | Carcinomatous ulcer in cardia of thoracic stomach |
| Christiansen (19) | 1941 | 1 | Adenocarcinoma of thoracic stomach |
| Smithers (20) | 1945 | 1 | Annular carcinoma at level of cardiac orifice in thorax |
| | | 5 | Cases seen by Dr. A. S. Johnstone (personal communication to Smithers) |
| | | 3 | Sir Thomas Dunhill in 1943 informed Smithers he had records of three cases of cancer in patients with short esophagus |
| Mailer (22) | 1948 | 1 | Adenocarcinoma in thoracic stomach |
| | | 2 | Dr. Frank T. Land, in a personal communication to Mailer, reviewed the records for the past ten years at the Western Infirmary, Glasgow, among which were two cases of carcinoma associated with short esophagus |
| Olsen and Harrington (23) | 1948 | 3 | Carcinoma in thoracic stomach with short esophagus |
| **Carcinoma of Pylorus** | | | |
| Schwartz (6) | 1919 | 1 | Left diaphragmatic hernia containing stomach whose pylorus was almost completely obstructed by cancer |
| Jackson (13) | 1938 | ? | Carcinoma of stomach in several patients with hiatal herniation of a part of the stomach |
| Harrington (16) | 1940 | 2 | Carcinoma of pylorus in hiatal hernia of stomach |
| **Traumatic Hernia** | | | |
| Wille (3) | 1912 | 1 | Cancer infiltrated stomach in abdomen associated with right-sided diaphragmatic hernia containing omentum and colon |
| Watt (5) | 1914 | 1 | Traumatic hernia through diaphragm complicated by cancer of the stomach in the hernia |

The patient was submitted for x-ray examination of the gastro-intestinal tract on May 9, 1949. Upon fluoroscopy, it was noted that the barium column flowed down the esophagus without hindrance or deviation until it reached the lower third of the esophagus. At that point there was a division into two streams around a polypoid mass. After the stomach had been filled, streaks of barium adhered to the surface of this diverting mass.

Complementary x-ray films (Fig. 1) showed that a portion of the stomach was herniated through the esophageal hiatus, that the esophagus was of normal length, and that the herniated portion of the stomach presented an irregular filling defect with distortion to absence of the normal gastric mucosal pattern at this site. It was felt that the herniated stomach was the site of a malignant polypoid mass protruding into the esophagogastric junction, thus accounting for the fluoroscopic image.

Operation (May 20), through a left thoraco-abdominal approach, revealed a hernia of the diaphragm, with one-third of the stomach in the thorax. A tumor was palpated on the greater curvature side of the esophageal opening of the stomach. The entire stomach plus the lower third of the esophagus was removed, followed by esophagojejunostomy.

Upon opening the stomach (Fig. 2), a large ulcerating mass involving both esophageal and gastric mucosa was found in the esophagogastric area. The mass was 6.5 cm. in length and up to 4 cm. in width. Most of the tumor was ulcerated, but around the margins was an irregular raised ridge composed of extremely firm but friable hemorrhagic tumor tissue. At the proximal end of the specimen, projecting from this ridge, was a polypoid mass measuring 2.5 cm. in maximum dimensions and extending 1.5 cm. from the surface.

Microscopic examination showed primary carcinoma of the stomach with extension to the esophagus.

The patient expired on the fourth postoperative day. Unfortunately, permission for postmortem examination was denied.

NOTE: Acknowledgment is made to Dr. C. Gottlieb, Director of the Department of Radiology, for his invaluable aid and advice, and to Dr. R. McGrath and Dr. R. F. Carter for their kind permission to present this case.

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## REFERENCES

1. HILL, J. D.: True Diaphragmatic Hernia with Stricture of the Oesophagus. Tr. Path. Soc. London **21:** 154–159, 1870.
2. EPPINGER, H.: Allgemeine und spezielle Pathologie des Zwerchfells. Leipzig, Nothnagel's Handbuch, Suppl. 1, 1911.
3. WILLE, H.: Et tilfælde av hernia diaphragmatica. Norsk. Mag. f. Lægevidenskap. **10:** 1733–1737, 1912.
4. VERSÉ: Hernia diaphragmatica vera. München med. Wchschr. **59:** 1193, 1912.
5. WATT, W. L.: Traumatic Hernia Through the Diaphragm, Complicated by Carcinoma of Stomach, Diagnosed by Means of the X-Ray. Brit. J. Surg. **2:** 174–177, 1914.
6. SCHWARTZ, A.: À propos des hernies diaphragmatiques, Bull. et mém. Soc. de chir. de Paris **45:** 958–964, 1919.
7. BÁRSONY, T., AND POLGÁR, F.: Beiträge zur Röntgensymptomatologie der Hiatusbruche. Fortschr. a. d. Geb. d. Röntgenstrahlen **37:** 174–177, February 1928.
8. HARRINGTON, S. W.: Diaphragmatic Hernia. Arch. Surg. **16:** 386–415, January 1928.
9. WOLF, G.: Über Hiatusbrüche. Klin. Wchnschr. **7:** 2007–2010, Oct. 14, 1928.
10. MÖLLER, F.: Zwerchfellhernie und Magenkarzinom. Acta med. Scandinav. **74:** 421–429, 1931.
11. HARRINGTON, S. W.: Surgical treatment of 105 Cases of Diaphragmatic Hernia. West. J. Surg. **44:** 255–269, May 1936.
12. UNGER, A. S., AND POPPEL, M. H.: Roentgen Diagnosis of Diaphragmatic Hernia. Am. J. Surg. **38:** 251–258, November 1937.
13. JACKSON, C. L.: Diagnosis of Cancer of Stomach. Tr. Am. Therap. Soc. **38:** 107–108, 1938.
14. JACOBS, L. G.: Carcinoma in a Case of Esophageal Hiatus Hernia. Am. J. Roentgenol. **40:** 381–382, September 1938.
15. JANKELSON, I. R., AND MOREIN, S.: Complications of Diaphragmatic Hernia. Rev. Gastroenterol. **7:** 134–143, March-April, 1940.
16. HARRINGTON, S. W.: Diagnosis and Treatment of Various Types of Diaphragmatic Hernia. Am. J. Surg. **50:** 381–446, November 1940.
17. HOLLAND, A. L., AND LOGAN, V. W.: Cancer Developing in Herniated Portion of Stomach. New York State J. Med. **40:** 216–217, Feb. 1, 1940.
18. RAVEN, R. W.: Thoracico-abdominal Gastrectomy for Carcinoma of Thoracic Stomach. Brit. J. Surg. **29:** 39–46, July 1941.
19. CHRISTIANSEN, H.: Brachyesophagus with Dystopic Cardia. Acta radiol. **22:** 360–366, 1941.
20. SMITHERS, D. W.: Short Oesophagus (Thoracic Stomach) and Its Association with Peptic Ulceration and Cancer. Brit. J. Radiol. **18:** 199–209, July 1945.
21. HARRINGTON, S. W.: Surgical Treatment of the More Common Types of Diaphragmatic Hernia: Esophageal Hiatus, Traumatic, Pleuroperitoneal Hiatus, Congenital Absence and Foramen of Morgagni. Ann. Surg. **122:** 546–568, October 1945.
22. MAILER, R.: Carcinoma in a Thoracic Stomach (Congenital Short Oesophagus). Brit. J. Surg. **35:** 426–428, April 1948.
23. OLSEN, A. M., AND HARRINGTON, S. W.: Esophageal Hiatal Hernias of Short Esophagus Type: Etiologic and Therapeutic Considerations. J. Thoracic Surg. **17:** 189–209, April 1948.
24. HARRINGTON, S. W.: Various Types of Diaphragmatic Hernia Treated Surgically. Report of 430 Cases. Surg., Gynec. & Obst. **86:** 735–755, June 1948.

## SUMARIO

### Carcinoma del Estómago Herniado a Través del Diafragma

El repaso de la literatura revela 35 casos de carcinoma asociado a hernia diafragmática del estómago. Por desgracia, los casos, en su mayor parte, no han sido descritos a fondo, y algunos apenas se mencionan de paso, por lo cual, parece imposible tratar de bosquejar un cuadro clínico que sugiera el diagnóstico de carcinoma complicando una hernia diafragmática. No obstante, el empleo de los exámenes complementarios, tales como esofagoscopia, gastroscopia y reconocimiento roentgenológico del tubo gastrointestinal en los casos de hernia gástrica, en particular en los que manifiestan hematemesis, melena o disfagia, descubrirá la mayor parte de los complicados por una neoplasia maligna

El caso presentado en este trabajo manifestó la semiología habitualmente asociada con la hernia hiatal gástrica avanzada, pero sólo después del examen roentgenológico se puso en claro la verdadera situación.

# Million-Volt Beryllium-Window X-Ray Equipment for Biophysical and Biochemical Research[1]

WM. T. HAM, JR.,[2] and E. DALE TROUT[3]

ROENTGEN-RAY equipment has been used extensively for studies on the biological effects of ionizing radiation. The apparatus described in this paper differs from conventional x-ray tubes only in the beryllium exit port. The inherent filtration of the beryllium window is negligible for most practical purposes. When suitable filters are interposed, hard x-rays are provided which can be used for whole-body irradiation studies on large animals; conversely, with no additional filtration and at short distances from the x-ray target, an intense beam of ionizing radiation is available for studies on small biological specimens or for research in radiation chemistry.

The present investigation concerns the physical characteristics of the x-ray beam emitted by a one-million-volt beryllium-window tube at distances ranging from 15 to 150 cm. from the source. Both red bakelite and black nylon thimble chambers have been used to explore the beam. The effect of a magnetic field on the ionization chamber readings has been examined. The x-ray intensities found available near the source suggested the feasibility of measuring directly the energy absorption in a column of water. Some preliminary experiments employing this method are reported.

The low inherent filtration of beryllium, while making possible the use of an intense beam of radiation, introduces a formidable problem for x-ray dosimetry. The free-air ionization chamber has been a primary standard for x-ray absorption measurements in air over the spectral range encountered in conventional medical practice. The Victoreen red bakelite thimble chamber has been used extensively as a secondary standard. Red bakelite chambers can be made to agree quite accurately with the free-air ionization chamber over a range of wave lengths from about 0.1 to 1.0 angstroms (1). On the other hand, beryllium-window tubes allow the transmission of x-rays extending from the cut-off wave length down to very long wave lengths, perhaps greater than 6 to 8 angstroms, depending on the magnitude of the excitation potential. The physical definition of the roentgen was intended originally for the conventional x-ray spectrum used in medical practice, and it can be defined operationally in terms of the standard free-air ionization chamber. Since the free-air chamber is physically impractical for wide spectral distributions at close distances to the target, there exists no primary standard for comparison with ionization measurements. There is a growing tendency to define ionization dosage from all types of radiation in terms of the energy absorbed per unit weight of irradiated material but, regardless of how this unit is defined and finally adopted, there remains the very real problem of how to measure the absorbed energy.

The theory of the ionization method as a means of determining energy absorption in an irradiated substance has been discussed by Gray (2, 3). The so-called air-wall chamber used in x-ray dosimetry must have walls thick enough to bring the primary radiation into equilibrium with the secondaries engendered in the wall material; this means that the walls must be thick enough to prevent the most energetic beta particle from reaching the gas

[1] From the Radiation Division, Surgical Research Laboratory, Medical College of Virginia, Richmond, Va. This work was performed under contract W49-007-MD-411; 0.1 No. 229–47. Medical Research and Development Board, Office of the Surgeon General, U. S. Army. Paper presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

[2] Medical College of Virginia, Richmond, Va.
[3] General Electric X-ray Corp., Milwaukee, Wis.

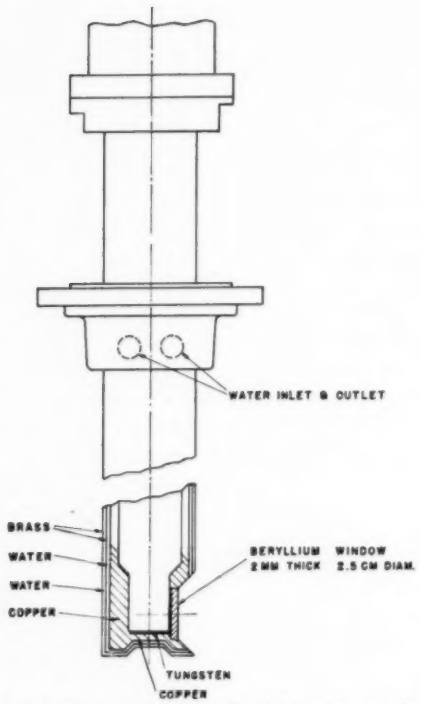


Fig. 1. Anode extension of million-volt beryllium-window tube.

within the ionization chamber. In practice, the wall can be somewhat thinner than the maximum range of the secondary electrons, since the major portion of the ionization due to electrons takes place near the inner edge of the wall (4). Thus, a thickness of about 0.025 inches of bakelite is found to be sufficient in the Victoreen red thimble chamber. Another stipulation of the theory is that the average range of the secondary ionizing particles in the gas cavity must be large in comparison to the dimensions of the cavity. This requirement is fulfilled except for very soft x-rays.

Black nylon thimble chambers with a wall thickness of 0.005 inches are available commercially from the Victoreen Instrument Company. When these chambers are calibrated in the same manner as red chambers, the two will agree over the ordinary 100 to 200-kv.p. range of filtered radiation as used in deep therapy. In the presence of soft radiation such as that emitted by a beryllium-window x-ray tube, the black chamber will read very much higher than a comparable red chamber because of the wall absorption effect, which becomes of major importance for the longer wave lengths. The demands of theory, as outlined by Gray, are not satisfied for a black chamber exposed to a wide distribution of x-ray wave lengths. Nevertheless, the black nylon chamber fulfills a very real purpose in modern x-ray dosimetry.

Rogers (5) and, more recently, Cassen (6) have measured the ionization intensity from beryllium-window tubes operated at 50 kv. Their results are somewhat conflicting. Day (7) has calibrated condenser r-meter thimble chambers of various types against a standard free-air ionization chamber for x-rays excited by potentials ranging from 10 to 200 kv. For x-ray tubes with low inherent filtration he finds that black nylon chambers require a smaller correction factor than red chambers, when compared with the free-air standard chamber. Day's measurements were made at distances of 119 cm. or more from the x-ray target. It would be helpful to have similar measurements at distances close to the source.

Trout and Gager (8) explored the radiation field from a beryllium-window tube operated over the range of 30 to 100 kv. (peak) and at distances ranging from 10 to 100 cm. from the target. They found that the correction factor for air absorption was very large. At distances of 100 cm. from the source, their air absorption correction factors compare favorably with those given by Day and Taylor (9).

## DESCRIPTION OF EQUIPMENT

Charlton *et al.* (10) have described the million-volt generator which is a 180-cycle resonant transformer. The beryllium-window x-ray tube incorporated into this power supply is similar to the one described by Trout and Atlee (11). The tube has a tungsten target placed at right angles to the electron beam. Figure 1 shows the anode construction. Adjacent to and extending above the tungsten target is a beryllium window 2.5 cm. in diameter and

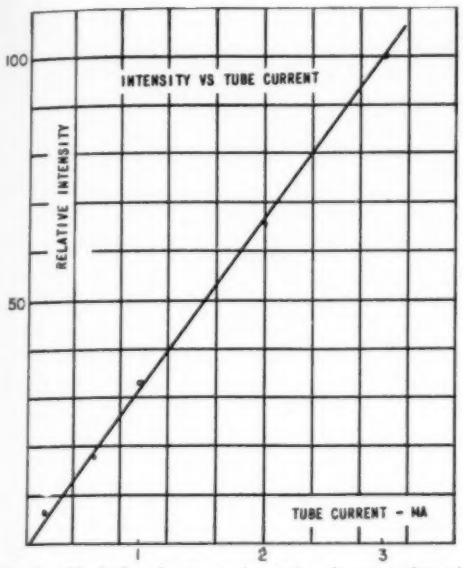


Fig. 2. Variation in x-ray intensity (r per minute) with tube current at 1,000 kv.p.

0.2 cm. thick. The data reported in this paper concern the reflected beam transmitted through this beryllium window at the full excitation potential of one million volts. The cathode is so designed that electrons are accelerated toward the anode only during the top portion (850 to 1,000 to 850) of the voltage cycle. Thus, under operation at one million volts, the tube current corresponds to 180 pulses per second of approximately 900 Kev electrons. The electron beam current is continuously variable between 0.1 and 3.0 milliamperes.

The anode extension shown in Figure 1 is encased in a lead cylinder, 1 inch thick. An aperture in the cylinder is provided for the reflected beam. Surrounding this cylinder is another lead cylinder 2 inches thick and containing a shutter mechanism which is operated by a solenoid. The shutter interposes 2 inches of lead in the beam from the beryllium window; when open, it allows the full beam from the beryllium window to be brought out into the room. The entire shutter mechanism and protective assembly can be rotated about the anode assembly or removed should it become desirable.

The assortment of thimble chambers comprised five 250-r black nylon chambers, two 250-r red bakelite chambers, one 100-r red bakelite chamber, one 100-r beryllium chamber, and one 25-r red bakelite chamber. One of the 250-r nylon chambers and the 25-r bakelite chamber were calibrated against a free-air ionization chamber at the National Bureau of Standards. This calibration was performed at 175 kv., 100 kv., and at 50 kv. The beryllium window on this x-ray tube was 0.15 cm. thick and the measurements were made at 100 cm. from the x-ray target. Readings were compared without additional filter and with 0.1 cm. of aluminum filter in the beam.

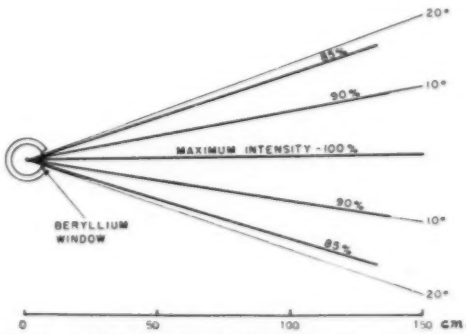


Fig. 3. Radiation pattern of the x-ray beam in a horizontal plane containing the focal spot.

Care was taken to avoid high dosage rates when exposing the chambers near the source. This was accomplished by running the electron beam current at 0.1 ma. and multiplying the chamber reading by a factor of 30 to obtain the reading for full milliamperage. The linearity of x-ray beam intensity as a function of tube current was checked by exposing the 25-r chamber for various currents. Figure 2 is a plot of the chamber readings in r/min. versus tube current in milliamperes. These readings were taken at 100 cm. from the unfiltered source with wide field irradiation.

## PHYSICAL CHARACTERISTICS OF THE BEAM

The spatial distribution of the unfiltered x-ray beam was determined by taking readings with the 25-r bakelite chamber at various positions. Figure 3 shows the beam pattern in the horizontal plane con-

taining the focal spot. The distribution of intensity is symmetrical about the line of maximum intensity which passes through the focal spot at normal incidence to the beryllium window. A large dog may be irradiated in a practically uniform field at a distance of 150 cm. from the source; the dosage rate at this distance is 33 r/min. for 1,000 kv.p. and 3.0 ma.

Figure 4 shows the intensity distribution in the vertical plane. The line of maximum intensity makes an angle of 15 degrees with a horizontal plane containing the focal spot. The same large dog at a distance of 150 cm. from the source and 120 cm. above the floor may be irradiated in a reasonably uniform field of 33 r/min.

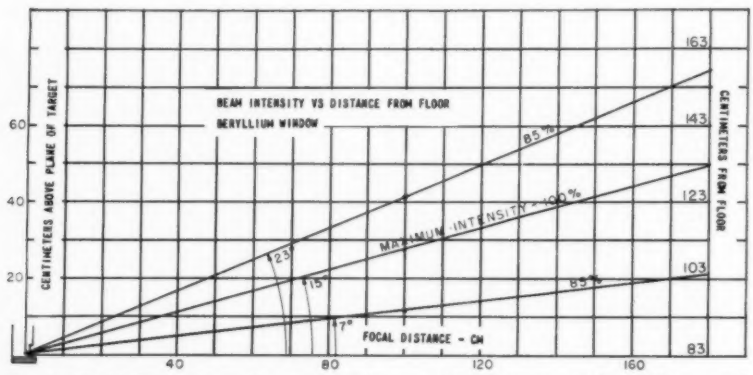


Fig. 4. Radiation pattern of x-ray beam in a vertical plane containing a diameter of the beryllium window.

Both the quality of the beam and the dosage rate are dependent upon the position in the vertical plane. Figure 5 illustrates the variation in quality, at a focal distance of 150 cm., for three different heights above the floor. These absorption curves in lead show a progressive softening of the x-ray beam with height above the horizontal plane containing the focal spot (the tungsten target is 83 cm. above the floor as shown in Figure 4). Curve A, taken at 90 cm. above the floor, has a half-value layer of 1.3 mm. of lead; curve B, 100 cm. above the floor, 0.75 mm. of lead; curve C, 125 cm. above the floor, 0.67 mm. of lead. Fortunately, the quality changes only slightly through the region of uniform dosage rate in the vertical plane. It is well known that for high exciting potentials the preponderance of the hard radiation is in the forward direction with respect to the electron beam. This may explain why the radiation is hardest near the horizontal plane containing the focal spot. The variation in intensity in the vertical plane is probably due to absorption within the tungsten target.

Depth dose measurements in masonite are shown in Figure 6. The masonite phantom was a rectangle, 50 cm. long, 25 cm. wide, and 20 cm. deep, roughly corresponding to the torso of a dog. The phantom was placed 120 cm. above the floor at a focal skin distance of 150 cm. This position represented the most uniform part of the radiation field both in regard to quality and dosage rate. Lead collimation around the source provided an irradiation field 30 cm. in diameter at the front surface of the phantom. The measurements were made with the 25-r bakelite chamber. No filters were placed between the beryllium window and the phantom.

### X-RAY DOSIMETRY NEAR THE SOURCE

Black nylon and red bakelite thimble chambers agree well when placed in the unfiltered beam at focal distances of 150 cm. or greater. In fact, the agreement of

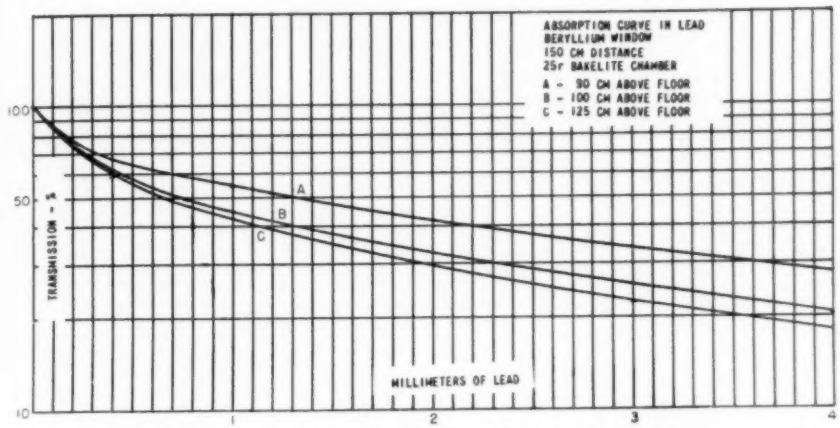


Fig. 5. Absorption curves in lead at three points in vertical plane for radiation from beryllium window.

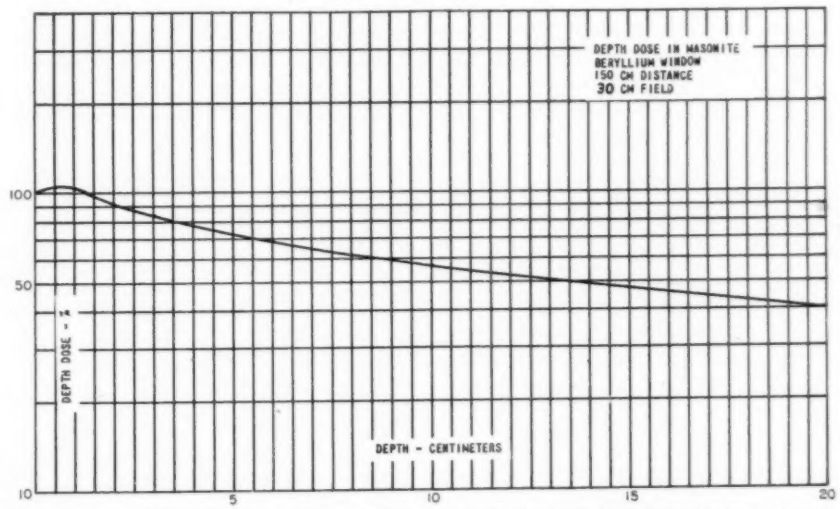


Fig. 6. Depth dose curve in masonite for unfiltered radiation from beryllium window; irradiation field, 30 cm. diameter; focal skin distance, 150 cm.

10 thimble chambers (5 nylon 250-r, 2 red 250-r, 1 red 100-r, 1 beryllium 100-r, 1 red 25-r) is to within less than 1.0 per cent at this distance. Such is not the case upon approaching the source. Figure 7 shows the variation among six typical chambers as the focal distance is varied from 25 to 150 cm. All readings were taken along the line of maximum intensity in the vertical beam (see Fig. 4) and the appropriate correction factors were used to give the true distance between focal spot and thimble chamber. The ordinate in Figure 7 gives thimble chamber readings in r/min. Curve A shows the variation of 4 nylon chambers. It will be noted that these chambers do not vary appreciably among themselves until a focal distance of 80 cm. is reached. The 25-r bakelite chamber reads consistently higher than the 250-r bakelite chamber as the source is approached. This is in keeping with Day's results (7), in that he found the 25-r bakelite chamber to agree more closely with the free-air ionization chamber than the 250-r bakelite chamber in the presence of soft

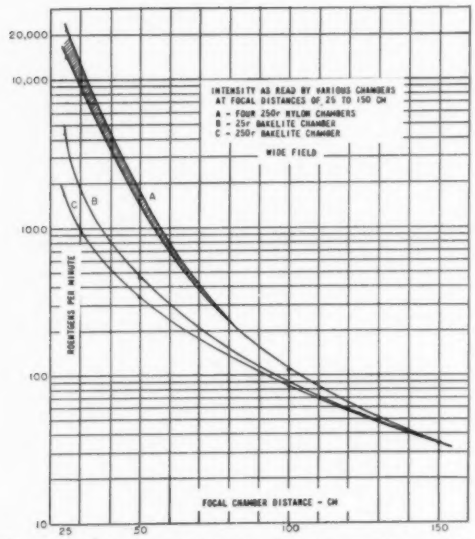


Fig. 7. Variation of thimble chamber readings with distance from x-ray target.

radiation. None of the chambers shown in Figure 7 follow an inverse-square law calculation as based on the agreement between chambers at a focal distance of 150 cm. This is attributable partly to air absorption, which becomes increasingly important as the source is approached. At a focal distance of 25 cm. the 4 nylon chambers read between 17,500 and 21,000 r/min., whereas the 25-r bakelite chamber reads 4,500 r/min. and the 250-r chamber reads 1,750 r/min.

Theoretical calculations on the energy distribution to be expected from a thick target bombarded by electrons of 900 Kev have been made, using Kramers' formula (12):

$$I_\lambda = KV^2(V_0 - V)$$

Here, $I_\lambda$ is the intensity or energy flux in ergs/cm.$^2$/sec. for radiation of wave length, $\lambda$, $K$ is a constant depending on the number of electrons striking a target of given atomic number, $V_0$ is the d.c. accelerating voltage, and $V$ is the voltage corresponding to a given wave length. The energy flux distribution has been plotted in Figure 8 as a function of wave length in angstroms. $I_\lambda$ is in arbitrary units. Kramers' formula predicts a maximum intensity at about 0.02 angstroms and a rapid fall in intensity with increasing wave length. The inherent filtration of the beryllium window produces no appreciable shift in this curve. Radiation passing through the beryllium window is restricted to angles greater than 90 degrees with the forward direction of the bombarding electrons and, since the preponderance of the hard radiation would be expected in the forward direction, there is reason to believe that a true energy spectrum would be shifted somewhat toward the longer wave lengths. Even taking this into consideration, there is no theoretical reason for predicting a large amount of soft x-radiation in the beam.

The effect of interposing polystyrene in the beam is shown in Figure 9. This figure gives the readings in r/min. for ten different thimble chambers at various thicknesses of polystyrene. It is interesting to note that 0.5 mm. of polystyrene brings all chambers into approximate agreement. Half-value layers determined at 25 cm. focal distance depend on the type of chamber used to make the measurement. For example, the half-value layer in aluminum as determined by the nylon chambers is 0.07 mm., whereas with a 250-r bakelite chamber it is 4.5 mm., which agrees well with the half-value layer in lead as determined at 150 cm. from the source.

The theoretical maximum intensity at 0.02 angstroms corresponds to a quantum energy of 613 Kev. Photoelectric absorption at this wave length is negligible. Compton recoil electrons would have a maximum energy of 433 Kev and a mean energy of 227 Kev. Electrons of this mean energy would have a range in air of roughly 40 cm., and their range in bakelite or polystyrene would be about 0.5 mm. Bakelite thimble chambers have a wall thickness of about 0.62 mm., which would be enough to exclude all but the most energetic recoil electrons. On the other hand, black nylon chambers have a wall thickness of only 0.13 mm., so that recoil electrons of mean energy 227 Kev could easily penetrate into the sensitive gas cavity.

An alnico magnet of 700 gauss was placed between the beryllium window and the

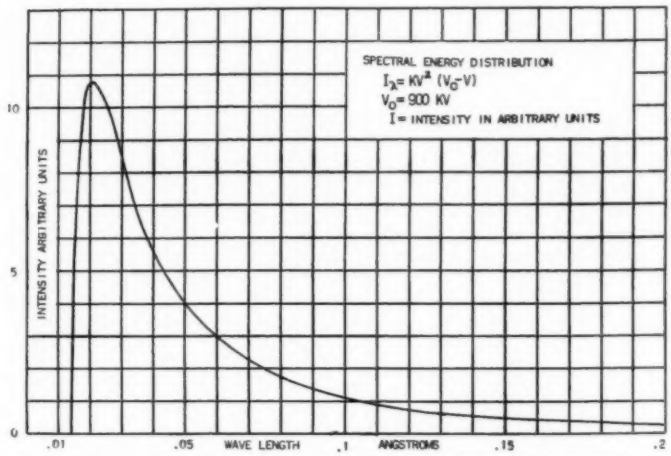


Fig. 8. Spectral distribution of radiation from thick target for an accelerating potential of 900 kv. as calculated from Kramers' theory.

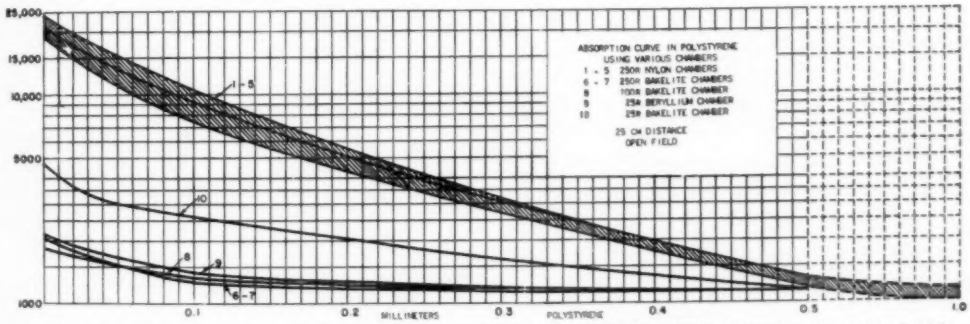


Fig. 9. Absorption curves in polystyrene as measured with ten different thimble chambers for wide-field irradiation at focal distance of 25 cm. from unfiltered beryllium-window beam.

thimble chamber to determine whether high-speed electrons were affecting the readings. Since this magnet had a spacing of only 1.5 inches between pole pieces, it was necessary to reduce the radiation field by using a hole of 1 inch diameter in the lead shutter. This collimating hole provided a 5.0-cm. diameter field at a focal distance of 25 cm. The magnet was placed at 17 cm. from the focal spot in such a position that the pole pieces were shielded from the direct beam by 3 inches of lead while the magnetic field completely covered the 1-inch collimating hole. Comparative readings without the magnetic field were obtained by substituting unmagnetized iron rods for the pole pieces under identical geometry. Readings with and without the magnetic field are shown in Figure 10 for the 250-r nylon chamber. The magnetic field reduces the reading from 4,300 r/min. to 1,300 r/min. with no filter in the beam. For thicknesses of polystyrene greater than 1 mm. there is no detectable difference in the readings with or without the magnetic field.

The effect of the magnetic field on the readings of the 250-r bakelite chamber are shown in Figure 11. With no magnetic field and unfiltered radiation, the chamber read 1,390 r/min.; with magnetic field the reading was 1,230 r/min. There was no detectable difference in readings for thicknesses of polystyrene over 0.5 mm. Nylon and bakelite chambers agree within 5 per cent when the magnetic field is present.

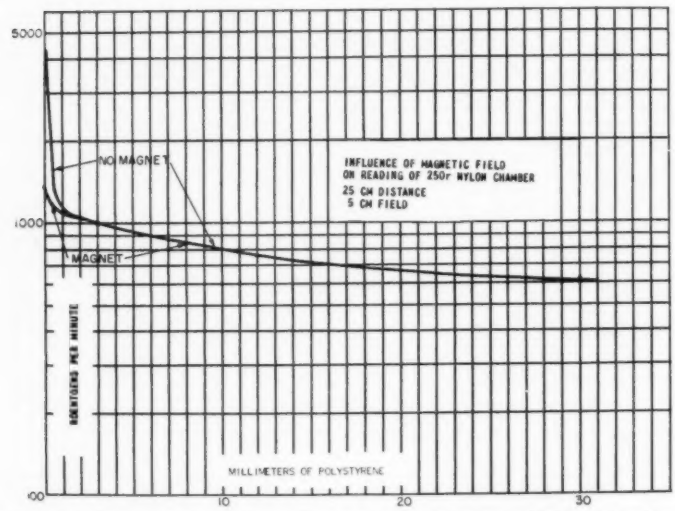


Fig. 10. Absorption curve in polystyrene at focal distance of 25 cm. showing influence of magnetic field on the readings of a 250-r black nylon chamber.

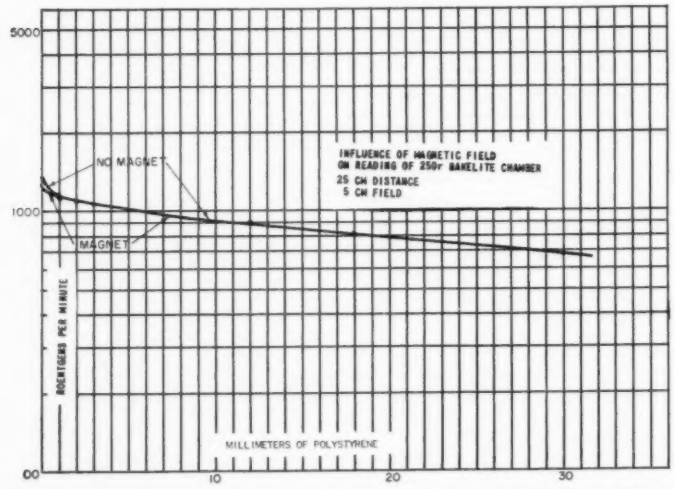


Fig. 11. Absorption curve in polystyrene at focal distance of 25 cm. showing influence of magnetic field on the readings of a 250-r red bakelite chamber.

It is concluded from these experiments that the spectral distribution of the reflected beam through the beryllium window does not differ markedly from that to be expected on the basis of Kramers' theory. Had there been a large amount of soft x-radiation in the beam, it is difficult to understand how the nylon and bakelite chambers could agree so closely with the magnetic field present.

The problem of dosage rate near the source is extremely complicated because of the presence of scattering material and the geometry of the radiation field. The experimental data indicate the presence of large numbers of beta particles. These must be recoil electrons and photoelectrons generated in the surrounding material near the target. Calculations show that electrons scattered from the tungsten target could not penetrate the beryllium window. Tissue dosage at the surface of a biological

specimen would be high because of these ionizing particles, and it is believed that the nylon chamber gives a good approximation of surface dosage.

Inverse-square-law calculations based on agreement of ten thimble chambers placed 150 cm. from the source for wide field irradiation yield a dosage rate of 188,000 r/min. at the surface of the beryllium window. This is a minimum dosage rate in air for hard electromagnetic radiation and ignores the ionizing beta particles near the window. On the other hand, since bakelite and nylon chambers agree within 5 per cent when corpuscular radiation is removed by a magnetic field, it is worth while to calculate the dosage rate at the window based on the readings of the bakelite chambers placed 25 cm. from the source in a wide radiation field. The 25-r bakelite chamber read 4,500 r/min. under these conditions. This calculation gives a dosage rate at the window of 700,000 r/min. Finally, if the readings of the nylon chambers at 25 cm. focal distance, wide-field irradiation, are taken as correct, the dosage rate at the window would be approximately 3,000,000 r/min.

### WATER ABSORPTION EXPERIMENTS

Accurate data on the energy absorption per gram of irradiated material are needed before the high intensities present at short focal distances can be used for quantitative research in radiation chemistry or on biological mechanisms. It is hoped that the experiments described below are a step in the right direction, but it should be emphasized that the results obtained up to the present time are highly problematic. The method is described because we believe it holds some promise for the x-ray dosimetry of beryllium-window tubes.

One roentgen is equal to the production of $1.61 \times 10^{12}$ ion pairs in 1 gm. of air; taking 32.5 ev (see ref. 4) as the average energy expended per ion pair in air, one roentgen corresponds to 83.8 ergs/gm. of air. Lea (13—Table 2, p. 8) has calculated that 1 r as measured in air is equal to the absorption of 93 ergs/gm. of water for radiation having a wave length of 0.02 angstroms. Thus, the temperature rise in 1 gm. of water would be 93 ergs/gm. divided by the mechanical equivalent of heat expressed in ergs/gm. °C. This amounts to a temperature rise of $2.2 \times 10^{-6}$ °C. Although this temperature rise for 1 r is too small to measure by ordinary laboratory technics, it becomes quite feasible for dosage rates of 50,000 to 100,000 r/min., where the rise would amount to 0.1 to 0.2°C per min.

A closed heat system requires elaborate insulation, which would introduce prohibitive amounts of absorbing material between the x-ray beam and the water. For this reason, a constant flow calorimetric technic was adopted. This method uses the differential temperature rise in a stream of fluid flowing at a known rate. Some of the difficulties inherent in a closed system are avoided, and the stream of fluid may be exposed to the x-ray beam through a minimum of filtration. The equation for the constant flow method, assuming that all of the heat is absorbed by the flowing fluid and that losses to the surroundings are negligible, is given by

$$\frac{dQ}{dt} = \frac{dm}{dt} J(T_2 - T_1)$$

where $dQ/dt$ is the time rate of heat input in ergs/min., $dm/dt$ the rate of passage of the fluid in gm./min., $J$ the mechanical equivalent of heat expressed in ergs/gm.°C, and $T_2$ and $T_1$ are the equilibrium temperatures reached by the fluid on the two sides of the heat source. If the flow rate for water is given in c.c./min., $dm/dt$ becomes equal to $D \times V$, where $D$ is the density of the water in gm./c.c. and $V$ is the flow rate expressed in c.c./min. For this experiment, the heat source was provided by an x-ray beam of constant intensity. Thus, $dQ/dt$ is given by the dosage rate in air, r/min., multiplied by the equivalent energy absorption in water, taken in this experiment to be 93 ergs/r. Therefore, if $J$ is taken as equal to $4.18 \times 10^7$ ergs/gm. °C, and $D$ as 1.0 gm./c.c., the equation becomes

$$\text{r/min.} = \frac{4.18 \times 10^7}{93} V(T_2 - T_1) = 45 \times 10^4 V(T_2 - T_1)$$

A schematic diagram illustrating the method is shown in Figure 12. Distilled water under a constant pressure head passes through a flow meter and a temperature equalizing bath (not shown) into a section of polystyrene tubing which is embedded in a polystyrene block (also not shown) having dimensions 14 × 10 × 1 1/2 inches. The central section of the block contains a hole 1 1/4 inch in diameter, across which flows the water stream encased in a section of nylon tubing 1 inch long and 3/8 inch in diameter. The thin nylon tubing (0.6 mg./cm.$^2$) is supported by two small polystyrene ribs. Nylon sheeting (0.6 mg./cm.$^2$) is placed over both sides of the hole in the block to protect the water stream from stray air currents. The entire assembly is placed adjacent to the shutter mechanism on the x-ray anode extension. The collimating hole in the lead shutter is 1 inch in diameter. When in position, only the water stream passing through the nylon tubing is exposed to the direct x-ray beam. The thermocouples and the remainder of the water stream are shielded from the direct beam by 3 inches of lead. The focal distance from the target to the center of the water stream is 17 cm. Total filtration between focal spot and water amounts to 0.2 cm. of beryllium, plus 15 cm. of air, plus two thicknesses of nylon having an air equivalent of 0.2 cm. In most of the experiments there was an additional filter of very thin aluminum foil having an air equivalent of 0.2 cm.

The thermocouples consisted of 10 copper-constantan junctions connected in series, 5 junctions on each side of the exposed water stream. The junctions were equally spaced across a diameter of the flowing water column. All connecting wires were buried in the polystyrene block. The thermocouple assembly was so constructed that it could be calibrated before insertion in the block. Two Beckman differential thermometers immersed in separate temperature baths were used to calibrate the thermocouples over a temperature range of 4 degrees C (19 to 23°C). All subsequent experiments were performed within this range. The e.m.f. was measured on a Rubicon microvolt potentiometer bridge, using a Leeds and Northrop Type E galvanometer which had a sensitivity of 1 mm./0. 4microvolt. The thermoelectric power was found to be 200 microvolts/°C.

A typical experimental run consisted in operating the x-ray tube at 1,000 kv.p. and 3.0 ma., with the lead shutter closed; dur-

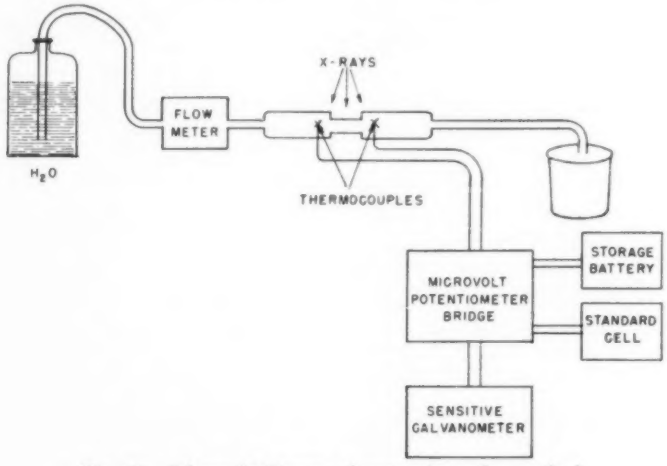


Fig. 12. Schematic diagram of water absorption method.

ing this part of the run the e.m.f. of the thermocouples was read on the bridge at thirty-second intervals over a period of about thirty minutes to determine the behavior of the temperature base line. Under favorable conditions, it was possible to maintain the slope of the base line to better than 1.5 microvolts per five-minute time interval. When the base line had attained reasonable stability, the lead shutter was opened by means of the solenoid. Readings were continued for twenty to thirty minutes at thirty-second intervals before shutting off the x-ray beam.

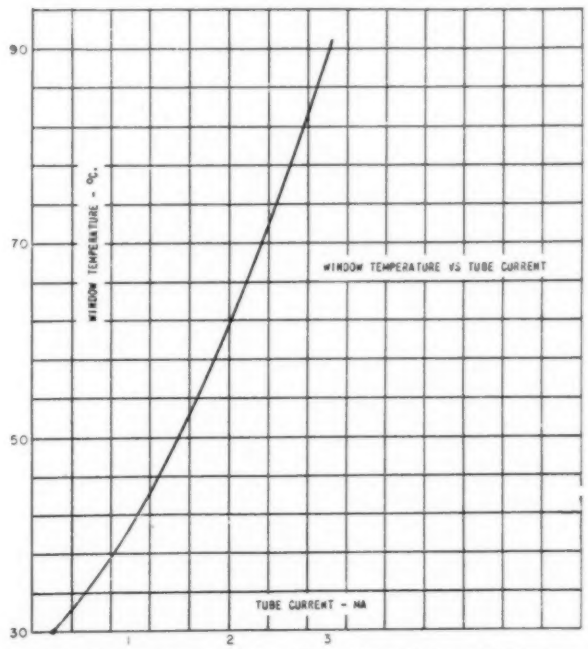


Fig. 13. Temperature variation of beryllium window with electron tube current at exciting potential of 1,000 kv.p.

The effect of thermal radiation from the beryllium window was investigated by measuring the temperature of the window with a copper-constantan thermocouple. Figure 13 shows the temperature of the window for various electron tube currents at an exciting potential of 1,000 kv.p. The maximum temperature attained by the window was 86°C for a current of 3.0 ma. A copper disk of dimensions comparable to the beryllium window was heated to 86°C by means of Nichrome wire embedded in furnace clay which was cemented to the back of the disk. Surface conditions of the beryllium window were simulated by painting the front surface of the copper disk with Aquadag. This disk was placed approximately 0.5 cm. in front of the beryllium window, and experimental runs were taken under identical conditions except for the absence of the x-ray beam. The temperature of the disk was measured continuously during the run. A differential temperature rise in the water of 0.05°C (9.5 microvolts) was attained during a twenty-minute run at a flow rate of 1.0 c.c./min. The experiment was repeated with an aluminum filter (equivalent to 0.2 cm. of air) in the beam. No detectable temperature rise in the water was observed. All subsequent runs included an aluminum filter in the beam.

The results for three typical runs at tube currents of 3.0, 2.0 and 1.0 ma. are shown in Figure 14. The e.m.f. of the thermocouples in microvolts is plotted along the

$y$-axis and the time in minutes along the $x$-axis. The past history of the temperature base line before the shutter was opened is not shown because of space limitations. The base lines for the 1.0 and 2.0 ma. curves were flat; the 3 ma. curve had an upward slope of 0.33 microvolts/min. The problem of stabilizing the base line is an inherent difficulty of the method. Increasing the flow rate stabilizes the base line at the expense of the accuracy with which the temperature rise can be detected.

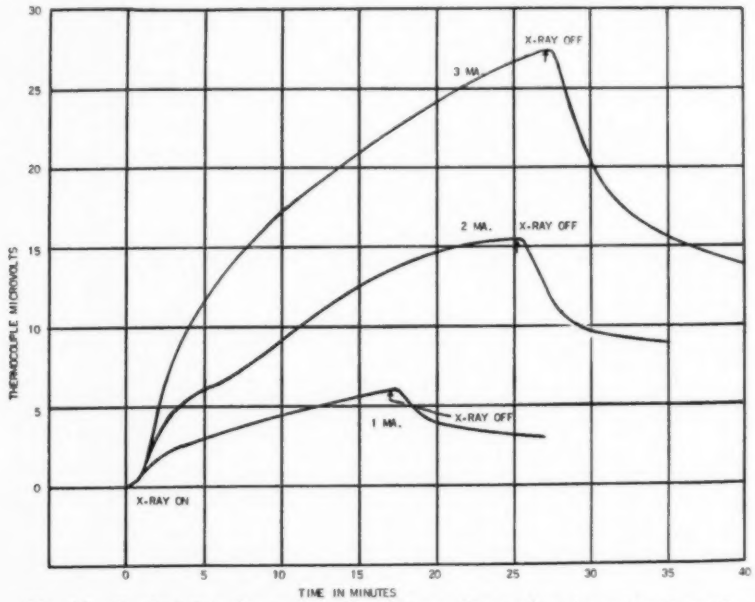


Fig. 14. Typical data for an experimental run, illustrating the water absorption method. Thermocouple e.m.f. is plotted as a function of time for tube currents of 3.0, 2.0, and 1.0 ma. at 1,000 kv.p.

In practice, a compromise must be chosen. The constant flow method assumes that temperature equilibrium is attained after a finite time. None of the curves shown in Figure 14 have approached temperature equilibrium at the time when the x-ray beam was turned off. In spite of these difficulties and others, such as loss of heat to the surroundings, thermal conduction through the thermocouple connections, and heat conduction through the water, it is interesting to calculate the dosage rate as indicated by these curves. It should be noted that all of the corrections enumerated above tend toward a minimum dosage rate calculation, with the possible exception of the inaccuracies in the temperature base line before the x-ray beam is turned on.

The flow rate for the 3.0 ma. curve was 1.35 c.c./min. The equilibrium temperature was taken as 27 microvolts, or 27/200 of one degree centigrade. The dosage rate calculated on this basis is 82,000 r/min. at a focal distance of 17 cm. from the focal spot. Similar calculations for the 2.0 ma. and 1.0 ma. curves give values of 51,000 r/min. and 20,000 r/min. respectively. These dosage rates should be linear with respect to tube current; the fact that this is only approximately true is indicative of the inaccuracies of the present method. Experiments have been performed keeping the tube current constant and varying the flow rate. The temperature rise should be inversely proportional to the flow rate, and this has been verified in a qualitative sense. The experimental inaccuracies of the method are too great at the present stage of development to warrant quantitative data on dosage rates near the beryllium window.

The mean value for the dosage rate in r/min. as derived from the three curves in Figure 14 is 73,000 r/min. at a focal distance of 17 cm. Inverse-square-law calculations on this basis indicate a dosage rate of better than 5,000,000 r/min. at the beryllium window. Nylon chambers at 17 cm. focal distance give readings of approximately 50,000 r/min. This amounts to a correction factor of 1.5. When due allowance is made for the wall thickness of the nylon chambers, these readings are comparable with the water absorption experiments.

## CONCLUSIONS

1. At distances of 100 cm. or more from the beryllium window, the x-ray beam consists of hard radiation. The half-value layer in lead is dependent on the location in the vertical plane, being 1.3 mm. of lead at a distance of 150 cm. from the source and at a height of 7 cm. above the horizontal plane containing the focal spot. The dosage rate also depends upon the location in the vertical plane—it is maximum along a line passing through the focal spot at an angle of 15° with the horizontal plane containing the focal spot.

2. The dosage rate of hard x-rays emitted at the beryllium window is about 188,000 r/min.

3. Near the beryllium window the x-ray beam contains a large component of ionizing radiation (beta particles) which is generated most probably in the collimating material surrounding the source.

4. Beta particles penetrate the walls of nylon thimble chambers placed near the beryllium window, causing these chambers to read much higher than comparable red bakelite chambers.

5. It is believed that surface tissue dosage near the beryllium window can be estimated more accurately with nylon chambers than with bakelite chambers. The water absorption experiments substantiate this view. Surface tissue dosage at a focal distance of 17 cm. from the unfiltered beam under the given experimental conditions is estimated to be 75,000 r/min.

6. Inverse-square-law calculations based on nylon chamber and water absorption dosage rates near the source are not considered valid as a means of calculating dosage rate at the beryllium window. All dosage rates near the source must be determined experimentally for each given set of conditions under which the irradiation is performed.

7. The water absorption method shows promise as a possible means of determining dosage rate at short focal distances from beryllium-window x-ray tubes.

NOTE: The authors are indebted to Dr. E. I. Evans without whose aid and support this work would not have been possible. Others who made valued contributions are R. C. Williams, K. R. Smith, and R. W. Stone. We are grateful to Miss Janet Armstrong for drawings and diagrams.

## REFERENCES

1. VICTOREEN, J. A.: Ionization Chambers. Proc., I.R.E. **37:** 189, February 1949.
2. GRAY, L. H.: Absorption of Penetrating Radiation. Proc. Royal Soc. (London), Series A **122:** 647, 1928.
3. GRAY, L. H.: An Ionization Method for the Absolute Measurement of Gamma Ray Energy. Proc. Royal Soc. (London), Series A **156:** 578, 1936. See also, Radiation Dosimetry. Brit. J. Radiol. **10:** 600, August 1937.
4. EVANS, R. D.: Radioactivity Units and Standards. Nucleonics **1:** 32, October 1947.
5. ROGERS, T. H.: A High Intensity Source of Long Wave-Length X-rays. Indust. Radiography **4:** 35, Winter 1945–1946. See also High-Intensity Radiation from Beryllium-Window X-Ray Tubes. Radiology **48:** 594, June 1947.
6. CASSEN, B., AND CURTIS, L. R.: Luminescence Measurement of the Roentgen Dosage of a Beryllium Window Tube. University of California, Atomic Energy Project, Report No. UCLA 39, December 1949.
7. DAY, F. H.: Thimble-Chamber Calibration on Soft X-rays. J. Research Nat. Bur. Standards **41:** 295, October 1948.
8. TROUT, E. D., AND GAGER, R. M.: Physical Characteristics of Soft Roentgen Rays. Am. J. Roentgenol. **62:** 91, July 1949.
9. DAY, F. H., AND TAYLOR, L. S.: Absorption of X-Rays in Air. J. Research, Nat. Bur. Standards **40:** 393, 1948. See also, Radiology **52:** 239, February 1949.
10. CHARLTON, E. E., WESTENDORP, W. F., DEMPSTER, L. E., AND HOTALING, G.: A Million-Volt X-ray Unit. Radiology **35:** 585, November 1940.
11. TROUT, E. D., AND ATLEE, Z. J.: Low-Absorption Roentgen-Ray Measurements from 500 to 1,000 Kilovolts. Radiology **48:** 604, June 1947.
12. KRAMERS, H. A.: On the Theory of X-Ray Absorption and of the Continuous X-Ray Spectrum. Phil. Mag. **46:** 836, 1923. See also, SPROULL, WAYNE T.: X-Rays in Practice. New York, N. Y., McGraw-Hill Book Co., 1946, p. 39.
13. LEA, D. E.: Actions of Radiations on Living Cells. New York, N. Y., Macmillan Co., 1947.

SUMARIO[1]

**El Aparato de Rayos X de Ventanilla de Berilio y de Un Millón de Voltios para Investigaciones en Biofísica y Bioquímica**

Los problemas especiales que es necesario resolver para realizar investigaciones sobre rayos X en el campo de la biofísica y de la bioquímica han sido motivo de que se busquen manantiales de rayos X que mejor se adapten a su solución. Los tubos de rayos X con ventanilla de berilio son adecuados especialmente para estos estudios.

A 100 cm. o más de distancia de la ventanilla de berilio, el haz de rayos X se compone de rayos duros. El espesor de la capa hemirreductora en plomo depende del lugar que ocupe en el plano vertical; es de 1,3 mm. de plomo a una distancia de 150 cm. del manantial y a una altura de 7 cm. sobre el plano horizontal en que se encuentra el punto focal. La proporción de la dosis también depende del lugar en el plano vertical; es máxima a lo largo de una línea que pase por el punto focal a un ángulo de 15° con el plano horizontal en que se encuentra el punto focal.

La proporción de la dosis de rayos X duros emitidos en la ventanilla de berilio es a razón de cerca de 188.000 r por minuto.

Cerca a la ventanilla de berilio el haz de rayos X contiene una gran parte de rayos ionizantes (partículas beta), que es generada lo más probablemente en el material colimador que rodea al manantial.

Las partículas beta penetran las paredes de las cámaras de dedal de *nylon* colocadas cerca a la ventanilla de berilio, haciendo que dichas cámaras muestren cifras mucho más altas que las cámaras comparables de bakelita roja.

Se cree que la dosis de la superficie de los tejidos cerca a la ventanilla de berilio se puede calcular más exactamente con cámaras de *nylon* que con cámaras de bakelita. Los experimentos acerca de la absorción del agua apoyan esta opinión. La dosis de la superficie de los tejidos a 17 cm. de distancia entre el foco y el haz no filtrado, bajo las condiciones experimentales dadas, se calcula que es de 50,000 a 75,000 r por minuto.

Los cálculos según la ley de la intensidad inversa al cuadrado de la distancia, a base de las proporciones de dosis con cámara de *nylon* y a base de la absorción del agua cerca al manantial no se consideran válidos como medio de calcular la proporción de la dosis en la ventanilla de berilio. Todas las proporciones de dosis cerca al manantial deben determinarse experimentalmente teniendo en cuenta en cada caso las condiciones dadas bajo las cuales se realiza la irradiación.

El método de la absorción del agua es método que promete como medio posible de determinar la proporción de la dosis a cortas distancias de los tubos de rayos X de ventanilla de berilio.

[1] Por los A.A.

# Axial Transverse Laminagraphy[1]

PROFESSOR A. VALLEBONA[2]

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In 1930 I succeeded in obtaining the first laminagraphs. I was followed in rapid succession by Ziedses des Plantes (1931), Bartelink (1932), and by Grossmann and Chaoul (1935). Since then, the method has been generally adopted under the names of planigraphy, stratigraphy, laminagraphy, and tomography.

Fig. 1. Geometrical factors involved in axial transverse laminagraphy. For explanation see text.

Preparatory experimental work tending toward cross-sectional study of the body was made by Kieffer in 1938, and by Amisano in 1944 and 1946. Early in 1947 more fruitful experiments on cross-sectional laminagraphy were conducted by myself and by Frain and Lacroix. Later in 1947 I was able to obtain satisfactory cross-sectional studies of the living patient.

Since then, with the help of my coworkers, I have been able to perfect this new method of examination. This method we have called axial transverse laminagraphy. The geometrical factors involved

Fig. 2. Unit for transverse laminagraphy. Ordinary laminagrams may also be obtained with this apparatus.

are shown in Figure 1. The roentgen beam is directed with considerable obliquity to the center of the desired cross section and reaches a film which is carried on a horizontal platform. This platform can be rotated simultaneously and in the same direction as the patient during the exposure. All shadows in the plane D-D′ will fall on the same points of the film during this rotation, while all shadows in other planes, such as B′-B, will either move on the film or be cast altogether outside of the film. It is obvious that the geometrical factors must be rigorously observed and that the axis of rotation of the patient and of the film must be in the same vertical plane as

[1] Translated by C. Gianturco, M.D. Accepted for publication in August 1949.

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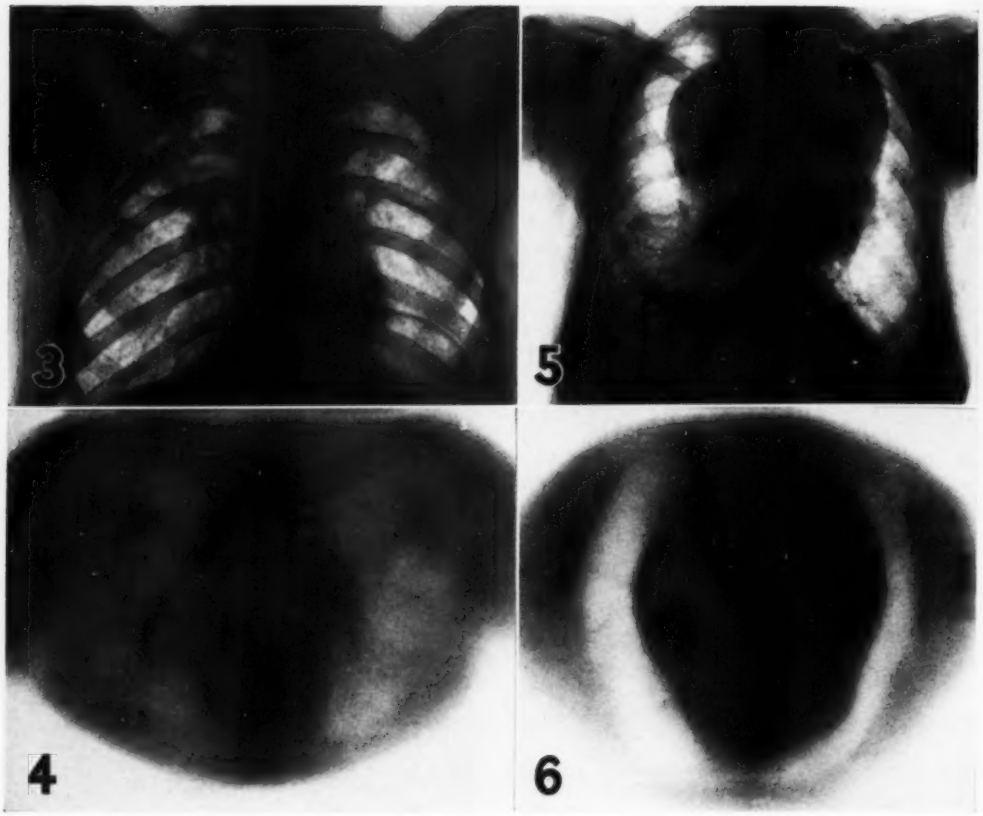


Figs. 3 and 4. Anteroposterior roentgenogram and transverse laminagram of chest with multiple tuberculous cavities.
Figs. 5 and 6. Aortic aneurysm as demonstrated on anteroposterior roentgenogram and transverse laminagram.

the central ray. The patient and the film turn 360 degrees during each exposure, and the time can vary from one-half to several seconds. Due to the obliquity of the incident radiation, the front screen of the cassette is not used because of its considerable opacity when struck at such high angles by the incident rays.

The actual construction of a unit for transverse laminagraphy has been undertaken by the Zuder Company of Genoa. Their unit, Figure 2, permits transverse laminagraphs as well as ordinary laminagraphy, allows changes in the time of rotation, and permits good positioning of the patient.

We have found the study of the chest and mediastinum a most useful field for transverse laminagraphy. Figures 3 and 4 show an anteroposterior roentgenogram and a transverse laminagram of a chest containing multiple tuberculous cavities. The appearance of an aortic aneurysm in the anteroposterior film and in the transverse laminagram is illustrated in Figures 5 and 6. The chest, however, is not the only region where transverse laminagraphy may be useful. Figure 7 is a transverse section of the skull at the level of the base.

It is as yet difficult to evaluate all the possible uses of this method. The transverse sections of the body it permits require new training in interpretation. Transverse laminagraphy will not replace the existing methods, but it is certainly capable of complementing them, especially

Fig. 7. Transverse section of the skull at the level of the base.

where accurate localization of lesions is important in the horizontal plane.

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SUMARIO

**Laminografía Transverso-Axil**

Describe aquí el A. un nuevo método de laminografía, denominado laminografía transverso-axil, que permite hacer el estudio del cuerpo en cortes transversales. Según revela la Figura 1, se asesta el haz de rayos X directamente en forma oblicua al centro del corte transversal deseado, yendo después a una película sostenida en una plataforma horizontal. Durante la exposición, que puede variar de medio segundo a varios segundos, se rotan 360 grados tanto la plataforma cuanto el enfermo.

# The Linea Innominata[1]

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IN REVIEWING the standard texts on the radiological anatomy of the skull, it is observed that the linea innominata is commonly considered to be a diagonal projection through the orbit (in the postero-anterior roentgenogram), *i.e.*, a straight line joining superiorly with the ridge formed by the posterior border of the orbital plate and inferiorly with the upper margin of the inferior orbital fissure.

This linea innominata is a radiological entity produced through a superimposition of densities attributed by present-day texts to the squamous portion of the temporal bone in tangential projection. Other authorities assert that it is produced by a tangential projection of the temporal squama, the greater wing of the sphenoid, or the junction of the two.

A one-quarter section of skull including the temporal bone was examined roentgenographically. Films were obtained with and without the temporal bone. The appearance of the line was the same in both (Fig. 1).

Fig. 1. Linea innominata without the temporal bone in place. The appearance was the same when the temporal bone was still in position.

In order to demonstrate the origin of this line, four pieces of the greater wing of the sphenoid were removed and a transverse groove was ground in the temporal surface of the greater wing, as illustrated in Figure 2.

First, with a saw, a curvilinear line was cut supero-inferior, 1/4 inch anterior to the most posterior margin of the greater wing where its suture line joins that of the temporal bone. With this piece (A) removed, the roentgenogram showed no decrease in density of the line under discussion. Distance, kilovoltage, and time were identical in all exposures.

Next, a pyramidal section (B), consisting of cerebral and temporal surfaces with interposed marrow was cut—the base of which was parallel to the floor of the middle cranial fossa. With the removal of this piece, an area of diminished density was seen in the x-ray film, involving not only the line but medially the back of the orbital surface of the greater wing. The temporal surface of the triangular segment removed paralleled the line and at one point caused a radiolucency.

A roughly triangular section (C), composed entirely of the superior-temporal surface was removed anteriorly up to the fronto-sphenoid suture line. The subsequent film showed a marked decrease in the linea innominata. Scoring of the temporal surface inferiorly (and anteriorly up to the zygomatic-sphenoid suture) with a dental burr, obliterated the radiological line pro-

[1] From the Department of Radiology, New York University-Bellevue Medical Center, University Hospital, New York, N. Y. Accepted for publication in October 1949.

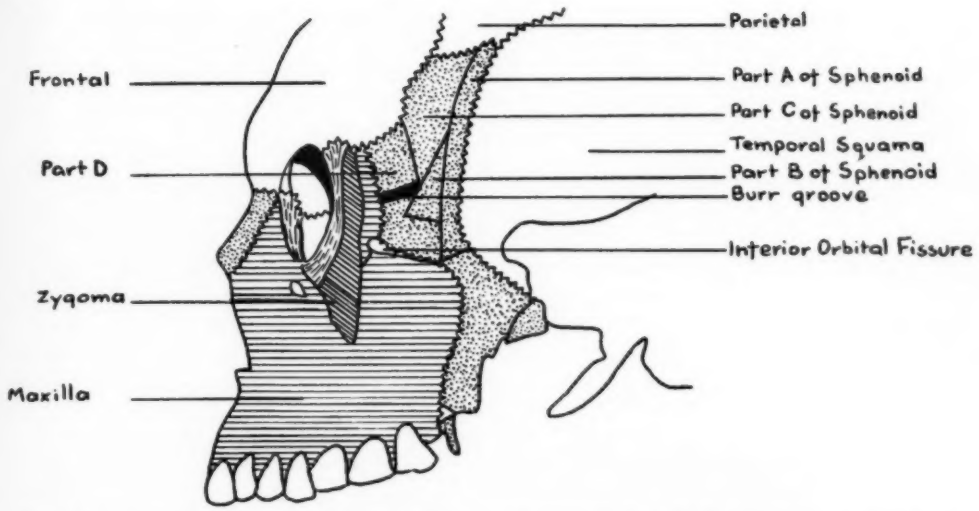


Fig. 2. Diagram of pieces of greater wing of the sphenoid removed, A, B, C, D, in sequence; lateral view.

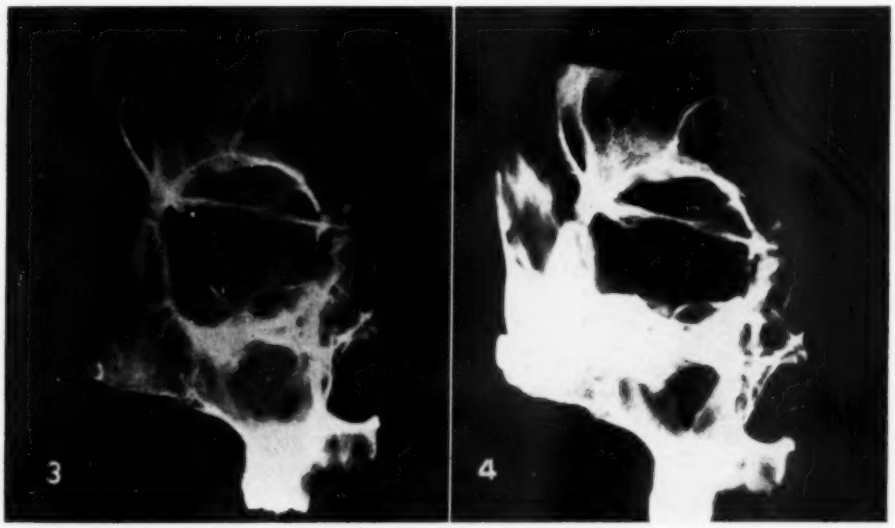


Fig. 3. Under-developed roentgenogram to show burr hole extending transversely from margin of the remaining temporal surface of the sphenoid to the spheno-zygomatic suture line.
Fig. 4. Roentgenogram obtained after removal of section D, showing absence of the upper half of the linea innominata.

duced by the temporal surface of the greater wing of the sphenoid (Fig. 3).

Removal of the remaining temporal surface above the burr line (segment D) resulted in absence of the upper half of the linea innominata, in the reontgenogram (Fig. 4).

These observations show that the oblique-lateral line seen projected in the orbit in the postero-anterior roentgenogram is composed in its entirety by the tangential projection of the temporal surface of the greater wing of the sphenoid. Furthermore, it can be seen that the portion of the

greater wing of the sphenoid which contributes most substantially to the linea innominata is that segment of the temporal surface curving roughly 1/4 inch posterior to the spheno-zygomatic suture line.

NOTE: Acknowledgment is made to Dr. Charles Gottlieb, Director of the Department of Radiology, New York University-Bellevue Medical Center.

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SUMARIO

**La Linea Innominada**

Está demostrado que la línea oblicuolateral que se ve proyectar en la órbita en la radiografia posteroanterior está formada totalmente por la proyección tangencial de la cara temporal del ala mayor del esfenoides.

Además, puede observarse que la porción de dicha ala que más contribuye a la línea innominada es el segmento de la cara temporal que encorva toscamente unos seis mm. detrás de la línea de la sutura esfenocigomática.

# EDITORIAL

## Spontaneous Pneumothorax in the Previously Healthy

The many reported cases of spontaneous pneumothorax since 1932, at which time Kjærgaard first collected and carefully analyzed 51 cases, all substantiate his claim that this is a distinct diagnostic entity, not related to tuberculosis or other chronic disease of the lung, and has a good prognosis. As early as 1884 it was recognized by West that pneumothorax might occur suddenly in the previously healthy who had no evidence of tuberculosis or other lung disease either before or after the attack. Osler's teaching that tuberculosis was the cause of spontaneous pneumothorax in 77 to 86 per cent of cases, a theory which he based upon the autopsy reports of Brach (1880) and Drasche (1899), still clouds the thinking of clinicians, despite the fact that the study of living pathology, particularly through roentgen examination, has clearly shown that tuberculosis is rarely associated with this clinical condition.

Spontaneous pneumothorax in the previously healthy is primarily a disease affecting young adult males. The most startling demonstration of this is furnished by the data of Schneider and Reissman, who reported from an induction station in the 2nd Service Command that approximately 1 man in 500 of draftee age gave a verified history of spontaneous pneumothorax. Previous estimates, made by authors reporting from college dispensaries, cite an incidence of 1 per 1,000 male students. The comparative incidence of spontaneous pneumothorax in the apparently healthy to spontaneous pneumothorax associated with pulmonary disease will vary greatly depending upon the type of patients seen and whether hospital or general office practice is considered. Of the 60 patients studied by the author, approximately two-thirds were ambulatory office patients and one-third were hospital patients. During the years (1915–46) that these 60 cases of spontaneous pneumothorax in the apparently healthy were gathered, 5 cases of spontaneous pneumothorax in patients having tuberculosis were found. Thus, the non-tuberculous form in this brief series is twelve times as common as the tuberculous form. This is approximately the ratio reported by Kjærgaard and others making comparison studies.

The extensive investigations of Kjærgaard and the excellent analytical work of Ornstein and Lercher have summarized the factual knowledge of the cause of spontaneous pneumothorax in an apparently healthy lung. The latter authors believe that it occurs from rupture of a thinned-out subpleural bleb which has formed as the result of a break in the elastic layers of the alveoli due to persistent over-distention of the apical portions of the lung produced by exertion.

That the subpleural bleb is a common finding is attested by the fact that anatomists have referred to it in descriptions of "normal" anatomy (Cunningham, Miller). There should be no confusion, however, between these emphysematous blebs which are the precursors of pneumothorax and the clinical entity of pulmonary emphysema. Emphysema occurs in an older group and is associated with diminished vital capacity due to loss of elasticity in the lung tissue.

Reports from the literature show that spontaneous pneumothorax is from two to twelve times as common in men as in women. The average ratio in over 500 cases is 5 males to 1 female. Over one-half of these cases occurred between the ages of twenty and twenty-nine; another 30 per

cent between the ages of thirty and thirty-nine. Spontaneous pneumothorax occasionally occurs in the newborn, but rarely in childhood and adolescence. In the histories of nearly all reported cases exertion and trauma seem to play an insignificant part.

Sudden pain in the chest is an almost universal symptom. Dyspnea is noted in about two-thirds of the cases, its severity varying with the degree of collapse. The diagnosis nearly always rests with the roentgenologist. Many years ago Dr. George Holmes pointed out that a film made in expiration will frequently reveal a small pneumothorax which is not demonstrable in the routine inspiration study. Nearly all roentgenologists have encountered cases which prove this.

Ordinarily all that is needed while symptoms are distressing is expectant treatment and bed rest. From 2 to 5 per cent of the cases may develop into severe tension forms, often with hemorrhage, making close observation during the first two days after onset important. In the past, aspiration has been resorted to in the severe tension forms, but with the presently perfected technics of chest surgery there would seem to be little reason to allow a patient to remain in this critical condition when surgical exploration could attack the site of hemorrhage and perforation directly. Similarly, surgery would seem the treatment of choice in persistent or recurring disabling spontaneous pneumothorax.

As radiologists, we may often be called upon to help the clinician evaluate his findings and we can certainly dispel the stigma of tuberculosis in cases of spontaneous pneumothorax in which we find, upon re-expansion, that the lung fields are clear. We are also duty bound to alert the clinician if our films show evidence of tension or extensive hemorrhage.

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REFERENCES

BRACH: Zur Aetiologie des Pneumothorax. (918 Cases) Wien. med. Wchnschr., Vol. 30, 1880.

DRASCHE: Ueber die operative Behandlung des tuberculösen Pneumothorax. (230 cases) Wien. klin. Wchnschr. **12:** 1117, 1149, 1899.

KJÆRGAARD, H.: Spontaneous Pneumothorax in the Apparently Healthy. Acta med. Scandinav., Supp. 43, pp. 1–159; 1–93, 1932.

KJÆRGAARD, H.: Pneumothorax Simplex. Two Cases with Autopsy Findings. Acta med. Scandinav. **80:** 93–104, 1933.

ORNSTEIN, G. G., AND LERCHER, L.: Spontaneous Pneumothorax in Apparently Healthy Individuals: Clinical Study of 58 Cases, with Discussion of Pathogenesis. Quart. Bull., Sea View Hosp. **7:** 149–187, April 1942.

SCHNEIDER, L., AND REISSMAN, I. I.: Idiopathic Spontaneous Pneumothorax: History of 100 Unselected Cases. Radiology **44:** 485–488, May 1945.

WEST, S.: Case of Complete Recovery from Pneumothorax without Effusion of Fluid. Tr. Clin. Soc. London. **17:** 56–59, 1884.

### MAINE RADIOLOGICAL SOCIETY

On June 19, 1950, a new name was added to the list of state and regional radiological societies. On that date the radiologists of Maine completed the organization of the Maine Radiological Society, adopting a working constitution and electing the following as permanent officers: President, Forrest B. Ames, M.D., of Bangor; Vice-President, Langdon T. Thaxter, M.D., of Portland; Secretary-Treasurer, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston; Members of the Executive Committee, Jack Spencer, M.D., of Portland, and Hugh Allen Smith, M.D., of Bangor.

### MINNESOTA RADIOLOGICAL SOCIETY

The Annual Spring Meeting of the Minnesota Radiological Society was held in Duluth, on June 12, during the annual session of the Minnesota State Medical Association. Dr. Eugene P. Pendergrass, Professor of Radiology, University of Pennsylvania, delivered the Carman Memorial Lecture, taking as his subject "The Roentgen Diagnosis of Silicosis." He spoke also at the Society dinner, on "Meningiomas."

### OKLAHOMA STATE RADIOLOGICAL SOCIETY

The Oklahoma State Radiological Society, meeting in Oklahoma City, on June 4, elected the following officers for the ensuing year: President, Peter E. Russo, M.D., Oklahoma City; Vice-President, H. B. Yagol, M.D., Ada; Secretary-Treasurer, Walter E. Brown, 21st and Xanthus, Tulsa 4.

### OREGON RADIOLOGICAL SOCIETY

The newly elected officers of the Oregon Radiological Society are: Benjamin Goldberg, M.D., of Corvallis, President; Richard J. Raines, M.D., of Portland, Vice-President; C. Todd Jessel, M.D., 214 Medical-Dental Bldg., Portland 5, Secretary-Treasurer.

### CONTINUATION COURSE IN NEUROLOGIC ROENTGENOLOGY
### UNIVERSITY OF MINNESOTA

The University of Minnesota announces a continuation course in Neurologic Roentgenology to be presented at the Center for Continuation Study, Oct. 30 to Nov. 4, 1950. Distinguished visiting physicians who will participate as faculty members of the course include Doctors Arthur E. Childe, Winnipeg; Philip J. Hodes, Philadelphia; Dabney Kerr, Iowa City; and Knut Lindblom, Stockholm, Sweden. Clinical and full-time members of the staff of the University of Minnesota and Mayo Foundation will complete the faculty.

Presentations on the anatomy and pathology of the central nervous system will be given early in the course. Emphasis will be placed throughout on different technics available for the roentgen examination of the central nervous system. Correlation of clinical and roentgenologic findings will be emphasized.

### ERRATUM

In the paper by Frederic N. Silverman on the Treatment of Leukemia and Allied Disorders with Folic Acid Antagonists, in the May 1950 issue of RADIOLOGY, the third line from the bottom of the first column on page 669 should read "transverse bands of *decreased* density" instead of "transverse bands of increased density."

## Books Received

CLINICAL THERAPEUTIC RADIOLOGY. U. V. PORTMANN, M.D., Editor, Head of Department of Therapeutic Radiology, Cleveland Clinic Foundation; Professor of Therapeutic Radiology, Bunts Educational Institute, Cleveland. A volume of 748 pages, with numerous illustrations. Published by Thomas Nelson & Sons, New York, 1950. Price $15.00.

MANUAL OF RHEUMATIC DISEASES. By W. PAUL HOLBROOK, M.D., AND DONALD F. HILL, M.D., Tucson, Arizona, with the assistance of CHARLES A. L. STEPHENS, JR., M.D. A volume of 182 pages, with 119 illustrations. Published by The Year Book Publishers, Chicago, 1950. Price $4.25.

TISSUE CULTURE TECHNIQUE. By Gladys Cameron, Department of Biology, Washington Square College, New York University. A volume of 192 pages, with 54 illustrations. Published by Academic Press Inc., New York, 2d ed., revised and enlarged, 1950. Price $4.20.

ARTERIOSCLEROSIS AND ARTERIAL THROMBOSIS IN THE LOWER LIMB. A ROENTGENOLOGICAL STUDY. Acta Radiologica Supplement 80. By ÅKE LINDBOM, of the Roentgen Diagnostic Department of Karolinska Sjukhuset, Stockholm; Chief: Professor Åke Åkerlund. A monograph of 80 pages, with 42 illustrations. Published by Esselte Aktiebolag, Stockholm, 1950.

PRAKTISCHE ELEKTROKARDIOGRAPHIE. EXTREMITÄTEN-EKG/BRUSTWAND-EKG. BELASTUNGS-EGK. By FRANZ KIENLE, Dr. med. habil., Dr. phil., Dozent für Innere Medizin, Chefarzt der II. Med. Klinik der Städtischen Krankenanstalten, Karlsruhe. A volume of 448 pages, with 426 illustrations. Published by Georg Thieme, Stuttgart, 3d ed., 1950. Agents for United States: Grune & Stratton, Inc., New York.

DIE KLINISCHE RÖNTGENDIAGNOSTIK DER INNEREN ERKRANKUNGEN. By PROF. DR. HERBERT ASSMANN. Sixth edition. Part I. 420 pages, with 501 illustrations and 10 tables, 1949. Part II. 604 pages, with 859 illustrations, 1950. Published by Springer, Berlin.

GASTRITIS, ULKUS UND KARZINOM. RÖNTGENSTUDIE UNTER BERÜCKSICHTIGUNG FORMAL-GENETISCHER BEZIEHUNGEN. By Prof. Dr. J. BÜCKER. Chefarzt der Röntgen-Abteilung des Allgemeinen Krankenhauses, Heidberg, Hamburg. A monograph of 90 pages, with 82 illustrations. Published by Georg Thieme, Stuttgart, 1950. Agents for United States: Grune & Stratton, Inc., New York.

## Book Reviews

CYTOLOGIC DIAGNOSIS OF LUNG CANCER. By SEYMOUR M. FARBER, M.D., MILTON ROSENTHAL, M.D., EDWIN F. ALSTON, M.D., MORTIMER A. BENIOFF, M.D. AND ALLEN K. MCGRATH JR., M.D. From the University of California Medical Service and the Department of Pathology, San Francisco Hospital and the San Francisco Department of Public Health. A volume of 79 pages with 60 illustrations, all in color. Published by Charles C Thomas, Springfield, Ill., 1950. Price $6.00.

The authors have pioneered a monograph with the additional feature of a comprehensive atlas which will be of great value to the pathologist and clinician interested in the cytology of pulmonary lesions. The larger portion of the work is given over to a very understandable exposition of wet-smear technic, followed by detailed descriptions of both malignant and non-malignant cells found in the sputum, bronchial secretions, and pleural fluid. The descriptions are supplemented by abundant colored photomicrographs of each of the cell groups. The photomicrographic reproduction is better than is customary for our era. The material studied comprised 4,366 specimens of sputum and bronchial secretions from 1,526 patients, of whom 1,254 were followed.

A detailed chapter on clinical and pathologic results will be of interest to the surgeon, roentgenologist, and general clinician. Cytologic reports of sputum revealing malignant cells were made in 59 per cent of 163 cases of bronchogenic carcinoma, when an average of 3 specimens per patient was examined. When an average of 5 sputum specimens per patient was examined, the positive cytologic diagnoses rose to 87 per cent of 110 cases of lung cancer. Study of the bronchial aspirate in 92 cases of primary carcinoma of the lung yielded 38 per cent with malignant cells, a very reasonable percentage under the conditions of collection. In only 2 instances in the entire series were false positive cytologic diagnoses rendered through utilization of the wet-smear method. Successful positive bronchoscopic biopsies were obtained in 50 per cent of 148 cases of bronchogenic carcinoma. When both sputum and bronchial aspirate were examined in the same patient, 64 per cent of 56 cases of proved lung carcinoma were correctly diagnosed cytologically. The greatest accuracy (92 per cent) was obtained when a complete cytologic study was combined with bronchoscopy.

In experienced hands the authors would place cytologic diagnosis alongside bronchoscopy in importance. They present evidence, furthermore, indicating that cytologic diagnosis may yield information not obtainable by bronchoscopy, particularly in the field of peripheral lung lesions.

In pointing to the simplicity and convenience of the method for the patient, the authors tend to minimize the implications of the ultimate burden to be borne by the laboratories. The space, time, and expense of technical help for screening cytologic material, and the demand on the pathologists, who of necessity must render the final cytologic diagnostic opinion, should not be overlooked, all the more so because of monographs such as this excellent one which attest to the fact that cytologic diagnosis has come into its own as a diagnostic weapon.

Roentgenologists in particular will be interested in the authors' suggestion that cytologic examination be made of the sputum of all patients with differential diagnostic problems arising from the mass miniature x-ray surveys of recent years.

LES TUMEURS MALIGNES DES VOIES AERO-DIGESTIVES SUPERIEURES. By J. DUCUING, Professor of Clinical Surgery and of Cancer and Director of the Anti-Cancer Center of Toulouse, and L. DUCUING, Former Laryngologist of the Anti-Cancer Center of Toulouse. A volume of 582 pages, with 170 illustrations. Published by Masson et Cie, Paris, 1949.

This excellently written and well illustrated book succeeds in presenting simply a very difficult subject. The first part of the book is devoted to the anatomy and the physiology of the pharynx and larynx. The second part consists of short considerations of the gross and microscopic pathology. The third part is formed by an excellent chapter describing the means and technic of exploration, including thorough use of radiographic examination. The

fourth part contains detailed consideration of technics of treatment, particularly of the numerous surgical interventions, but also with a very thorough critique of roentgen therapy and curie therapy, and a description of the indications of every one. The fifth part takes up each anatomical location of malignant tumor of the nasopharynx, mesopharynx, hypopharynx, and larynx, each of which is analyzed from points of view of etiology, clinical evolution, diagnosis, treatment, and result.

This is an excellent presentation and, indeed, the most thorough and up-to-date publication on the subject. The authors, the well known cancer surgeons of the Cancer Center of Toulouse, France, are old masters of medical didactics, endowed with rich experience and a rare pedagogic gift; this, their latest work, will be most appreciated.

# In Memoriam

## JAMES CURRIE McMILLAN, M.D.
1883–1950

James Currie McMillan died May 25, 1950, in the Shaughnessy Military Hospital, Vancouver, B. C., after a lengthy illness initiated by a coronary attack and followed some months later by a cerebral thrombosis.

Dr. McMillan was born in Minto, Manitoba, the son of an early settler who came from Scotland to farm in western Canada. He attended Brandon College, Manitoba College, and finally the Medical College of the University of Manitoba, where he was graduated in 1907. Following a period of general practice, he became associated with the X-ray Department of the Winnipeg General Hospital in the days of the induction coil and gas tubes. He was no sooner launched on this new venture, destined to become his life work, when World War I intervened. He served in the 11th Field Ambulance, C.A.M.C., in Canada, England, and France. After the war he returned to Winnipeg, to become Director of the Department of Radiology, Winnipeg General Hospital, a position he held for more than thirty years. He established a private radiological practice when radiology had barely reached the dignity of a specialty. Throughout his career he was untiring in his devotion to the advancement of radiology and yearly spent at least a month visiting centers in the United States and Europe.

James Currie McMillan, M.D.

Dr. McMillan was a life member of the Winnipeg Medical Society, a Past-President of the Manitoba Medical Association, and a charter member of the Canadian Association of Radiologists. He was a former member of the Radiological Society of North America, Fellow of the College of Radiology, Fellow of the American College of Physicians, and a Fellow of the Royal College of Physicians, Canada.

Surviving Dr. McMillan are his wife, a son, two grandchildren, a sister and two brothers.

R. A. MACPHERSON, M.D.

# RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

*Editor's Note:* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Philadelphia, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37, Ill.

**Alabama**

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

**Arizona**

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

**Arkansas**

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

**California**

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Clifford W. Wauters, 701 High St., Auburn. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

**Colorado**

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

**Connecticut**

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

**District of Columbia**

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

**Florida**

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John J. McGuire, M.D., 1117 N. Palafox, Pensacola. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, David Kirsh, M.D., 712 duPont Bldg., Miami 32. Meets monthly, last Wednesday, 8:00 P.M.

**Georgia**

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ted F. Leigh, M.D., Emory University Hospital. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of State Medical Association.

**Illinois**

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Harold L. Shinall, M.D., St. Joseph's Hospital, Bloomington.

**Indiana**

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*. William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

**Iowa**

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

**Kansas**

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

**Kentucky**

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

**Louisiana**

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday

**Maine**

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston

**Maryland**

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

**Michigan**

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, George Belanger, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

**Minnesota**

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

**Missouri**

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, H. R. Senturia, M.D., Pasteur Medical Bldg. Meets on fourth Wednesday, October to May.

**Nebraska**

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John E. Downing, M.D., 816 Medical Arts Bldg., Omaha. Meets monthly, fourth Thursday.

**New England**

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at the Harvard Club.

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Peter Gianquinto, M.D., St. Barnabas Hospital, Newark. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

**New York**

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, John L. Olpp, M.D., 49 Ivy Lane, Tenafly, N. J.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Vaughn Winchell, M.D., 40 Meigs St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D , Professional Bldg., Charlotte 2. Meets in May and October.

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 807 Broadway, Fargo.

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, E. C. Elsey, M.D. Meets last Monday, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:45 P.M. on fourth Monday, October to April, inclusive.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

**Oregon**

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Todd Jessell, M.D., 224 Medical-Dental Bldg., Portland 5. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St.

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SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, S. H. Fisher, M.D., 107 E. North St., Greenville. Meets with State Medical Association in May and at the call of the President.

**South Dakota**

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**Tennessee**

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 19-20, 1951, in Galveston.

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meetings fourth Monday, October through May, at College Club, Seattle.

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Meets in May and with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

**Puerto Rico**

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

## CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Jean Bouchard, M.D. Associate Honorary Secretary-Treasurer, D. L. McRae, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 26, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

## CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

## MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

## PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

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# ROENTGEN DIAGNOSIS

## THE HEAD AND NECK

**Radiological Diagnosis of Lipoma of the Corpus Callosum.** David Sutton. Brit. J. Radiol. **22:** 534–539, September 1949.

Two cases are added to the meager literature of the radiologic diagnosis of lipoma of the corpus callosum, one proved and the other presumptive. The proved case showed the semicrescentic calcified shadow, spreading of the anterior portions of the lateral ventricles, and upward displacement of a slightly enlarged third ventricle, described by others. The translucency described by Sosman (discussion of paper by Echternacht and Campbell, Radiology **46:** 148, 1946) was not clearly seen. The presumptive case showed both the typical translucency and bilateral crescentic calcified shadows. Vertriculographic studies were not made in this latter case.

Three roentgenograms; 1 photomicrograph.

SYDNEY J. HAWLEY, M.D.
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**The Frontal Sinuses in Bronchiectasis. A Study of the Morphological Basis of Lung Disease.** Johan Torgersen. Acta radiol. **32:** 185–192, Sept. 30, 1949.

It has been shown that frontal sinuses are small in individuals showing bronchiectasis. The present study comprises a comparison between cases of bronchiectasis which may be regarded as congenital and cases which are mixed with regard to etiology. The author has previously dealt with the frequent occurrence of bronchiectasis in individuals showing situs inversus (Acta radiol. **28:** 17, 1947). These cases are held to be congenital in origin. Seventy of the authors' cases (20 of uncomplicated situs inversus; 20 of situs inversus with bronchiectasis, and 30 of bronchiectasis alone) are analyzed and are compared with 86 cases reported by Kartagener (Ergebn. d. inn. Med. u. Kinderh. **49:** 378, 1935).

In all cases of bronchiectasis taken together, a significant difference was found in the size of the frontal sinuses as compared with the size of the frontal sinuses in 400 skull roentgenograms. In the bronchiectatic group the frontal sinuses were absent in 16 per cent and in the routine films the frontal sinuses were absent in 5 per cent. There was a significant difference shown in the size of the frontal sinuses in the cases of bronchiectasis with situs inversus as compared with the cases of uncomplicated situs inversus. The difference between the other groups was not significant. It was noted, however, that the individuals showing bronchiectasis with normal situs occupied an intermediate position between the uncomplicated cases of situs inversus and those of situs inversus with bronchiectasis. The sinuses are thus probably smaller in the congenital group than in the group of mixed etiology.

From these findings it is concluded that the observation that the frontal sinuses are small in bronchiectasis is to be explained by the small sinuses in the congenital cases. Small sinuses may therefore be a clue to the evaluation of the relative importance of hereditary factors in the particular case. The author discusses a possible genetic foundation for these observations.

Three roentgenograms; 1 table.

F. R. MCCREA, M.D.
Indiana University

**Cephalocele of the Posterior Part of Orbit. General Survey, with Report of Case.** Brynjulf Strandberg. Arch. Ophth. **42:** 254–265, September 1949.

By cephalocele of the posterior part of the orbit is understood cerebral hernia arising from the middle cerebral fossa and penetrating behind the bulbus oculi, through a preformed or non-preformed opening in the orbital wall. The author believes that the lesion is a congenital malformation due to failure in ossification rather than a condition following cystic degenerative arachnitis, as previously held.

The present survey comprises 31 cases collected from the literature between 1841 and 1948, in which the symptomatology was characteristic and in which roentgenologic or postmortem examination of the cranium established the presence of a hernial formation containing substance of the middle cerebral fossa and extending into the orbit behind the bulbus, as well as cases in which exploratory operation of the orbit revealed tumors consisting of brain tissue—with or without membranes and with or without cystic degeneration—and cerebrospinal fluid.

The most frequent ocular symptom of cephalocele of the posterior part of the orbit is a slowly developing unilateral exophthalmos, which appears chiefly in younger persons and, in the majority of cases, pulsates synchronously with the pulse and is reducible by pressure on the bulbus, usually without accompanying cerebral symptoms but sometimes associated with vertigo and nausea. The exophthalmos may change in relation to the cerebrospinal pressure, but the pulsation in most cases remains unaffected by compression of the carotid artery on the affected side. The eyeball is displaced, most frequently downward and laterally, but in a few instances downward and medially if the deficiency is located in the lateral wall of the orbit. Movement of the eyeball is hampered; there is edema of the eyelids, and a palpable soft, elastic tumor is present in the orbit.

Roentgenographic or postmortem examination in 15 cases revealed deficiencies in the orbital wall (in the posterior wall in 8 cases; in the most posterior part of the roof in 4 cases; in the side wall in 3 cases). In 2 instances the sella turcica was enlarged. Other defects causing cephalocele of the posterior part of the orbit were the absence, in 5 cases, of the lesser wing and/or parts of the greater wing of the sphenoid bone. In 2 cases there appeared, simultaneously, a cephalocele from the posterior cerebral fossa; in both instances the defect was located in the occiput. In 6 cases there were reported fistulas from the ventricular system to the cephalocele.

Operative treatment was reported in 23 cases; death followed operation in 7. The results in the series indicate that the patients are best served by operations similar to those for hernial lesions, *i.e.*, craniotomy, reposition of the contents of the hernia and substitution according to the defect—bone transplantation in smaller defects, gel film in larger ones, or dural substitute, if and when practicable.

The author reports in detail one case of cephalocele of the posterior part of the orbit in a 6-year-old girl, with roentgenographic, ventriculographic, and arteriographic findings.

Three roentgenograms; 2 photographs.

## THE CHEST

**New Studies of the Radiologic Appearance of the Lungs of Drowning Victims.** Pierre Trocmé and Raoul Lebert. J. franç. de méd. et chir. thorac. **3:** 308–313, 1949. (In French)

According to the teachings of legal medicine, a submerged individual first suspends respiration and then inhales large quantities of water approximately three minutes after immersion. At that time the bronchial tree and the alveoli are flooded. Consequently the authors found normal radiologic images of the lungs in persons who were promptly rescued from drowning and major changes in those who, having passed the critical period, were resuscitated by artificial respiration.

Most of the subjects studied were examined radiographically twenty to thirty-six hours after the accident and showed patches of ill-defined low-grade opacities with indistinct borders in the perihilar zones and the inner border of the pulmonary bases. These gradually and completely resolved in five to ten days.

The inability to procure immediate roentgenograms of drowning persons led the authors to experiment with immersed cats. These showed at first homogeneous widespread opacities in the perihilar and basal portions of the lungs, and subsequently revealed the spotty opacities described above, from which it was deduced that the irregular opacities found in human beings probably followed homogeneous shadows occurring at an earlier time. Two recent drowning victims showed such secondary changes.

There are, in all likelihood, three phases in the evolution of the changes in immersed lungs, as follows:

(1) An initial phase, of very brief duration, characterized by wide zones of homogeneous opacity in the perihilar and basal areas of the lungs. Where artificial respiration has been used, some fragmentation of the image is already seen.

(2) An intermediate phase, of five to ten days duration, with spotty, ill-defined semi-opacities in the same areas as the initial phase.

(3) A terminal phase, showing either complete recovery or varied images produced by complications.

The existence of the first phase can be surmised because of a few accidents such as flooding of the lung during a pleural lavage for a pyothorax with bronchopleural fistula. In one patient this reproduced the three phases mentioned above; on the other hand, the introduction of 40 to 50 c.c. of an aqueous solution of penicillin in the lungs produced no visible changes, probably because of the small quantity of fluid used. The second phase can show a rapid resolution or last eight to ten days and must be due to an irritative, inflammatory, or vasomotor reaction, since the lung could easily absorb by osmosis any fluid introduced into it. It differs from acute cardiac pulmonary edema, since there is no effusion in the pleural cavity or the interlobar fissures.

Since the introduction of antibiotic drugs, very few complications have appeared in the third phase. These were formerly quite frequent, especially when drowning had occurred in polluted water. Some residual thickening of pulmonary markings has been seen, nevertheless, persisting for several months, despite the use of antibiotics.

Three roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

**Bronchiectasis and Its Management. A Report of 277 Cases.** Carlton R. Souders. Dis. of Chest **16:** 381–407, October 1949.

The author reports his observations on 277 unselected cases of bronchiectasis seen at the Lahey Clinic (Boston) from 1936 to 1948. All age groups were represented and the sex distribution was about equal. The presenting complaints in the order of frequency were cough, hemoptysis, chest pain, dyspnea, asthma, frequent colds, malaise or fatigue, sputum, weakness, unexplained fever, and unrelated symptoms. The chief symptoms are cough, sputum, hemoptysis, dyspnea, and chest pain. Most patients had physical signs in the chest such as râles or suppressed breath sounds over the affected lobe. Clubbing of the fingers was present in about 20 per cent of the cases; in about 10 per cent there were no physical findings. The pathogenesis was not always clear-cut. Bronchial obstruction and infection are considered to be two of the most important etiologic factors. About 20 per cent of the patients had allergic manifestations.

Chest roentgenograms, before instillation of iodized oil, were considered abnormal in a high percentage of the cases in this series (251 to 277). Instillation of iodized oil is used for confirmation and localization and is considered a necessary procedure before surgery. All five pulmonary lobes should be visualized "so that an accurate base line is obtained from which to judge how much surgery to advise and to evaluate postoperative results and complications." Bronchoscopic examinations were made in 101 cases.

The lobes involved were as follows: right upper 25; right middle 103; right lower 164; left upper 26; lingula 75; left lower 194. One lobe was involved in 100 cases; 2 lobes in 86; 3 in 50; 4 in 21; 5 in 2; and all 6 in 6 cases. Unilateral disease was present in 145 cases and bilateral disease in 121.

In this series 93 patients had associated disease of paranasal sinuses; 69 had suppurative lesions, and in 24 cases the membranes were hyperplastic. Twenty-four patients were found to have tuberculosis, usually as a healed scar.

Symptoms may be relieved by antibiotics. Only the surgical removal of the diseased area can produce a cure. Medical measures, while useful, are not curative. Surgery is advised for patients with more than minimal disease or minimal symptoms but is contraindicated by old age, poor general condition, severe associated disease, such as valvular or coronary disease, hypertension, nephritis, emphysema, malignant disease elsewhere, brain abscess, asthma, active tuberculosis, etc. In the present series 78 patients had 95 operations, with the removal of 126 lobes or segments.

One hundred and ninety-four patients were treated and followed long enough for evaluation of results. In 37, including 2 treated surgically, no improvement was obtained. Seven were reported worse, and of these 3 had surgery. Varying degrees of improvement from slight to moderately great, with or without restriction of activity, were graded +1, +2, or +3: 39 were graded +1 (1 treated surgically); 34 were graded +2 (10 treated surgically); 36 were graded +3 (21 treated surgically). Eleven cases graded +5 were complete cures, while 30, graded +4, had only minor symptoms not directly related to bronchiectasis or minor restriction of activity after treatment. Of these 2 groups, all except 3 had surgery.

Unless it is possible to obtain a radical cure by sur-

gery, bronchiectasis must be managed by a complete program carefully followed by the patient in full cooperation with an interested physician.

HENRY K. TAYLOR, M.D.
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**Middle Lobe Bronchiectasis with Hemoptysis.** P. Santy, M. Bérard, P. Galy, and Ollagnier. J. franç. de méd. et chir. thorac. **3:** 376–385, 1949. (In French)

More attention has been paid recently to pulmonary ailments strictly localized to the middle lobe. Diseases of this area frequently reveal a peculiar clinical picture and present their own therapeutic problems.

The authors present 6 cases of bronchiectasis localized to the middle lobe, with recurrent rather severe hemoptysis as the main feature of the disease. The patients were all in the younger age group, ranging from fourteen to thirty-two years. Purulent expectoration was so slight in these cases that it led the clinician to think of other conditions than bronchiectasis. In every patient the chest films in two planes showed a more or less atelectatic condensation of the middle lobe. Bronchoscopic studies revealed varying appearances from stenosis to inflammatory swelling or mild dilatation of the bronchial orifice of the middle lobe. Bronchograms showed either saccular or cylindrical dilatations of the middle lobe or failure of filling. At no time was any tumor or parenchymal tuberculosis discovered. All cases were treated by surgical removal of the middle lobe, which sometimes proved difficult because of enlarged hilar nodes. The pathogenesis of the bronchiectases was varied, but no tuberculous or neoplastic cases were included in this study. The preoperative control of bleeding frequently proved difficult.

Three roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

**Tuberculosis in Nurses: Clinical Observations on Its Pathogenesis as Seen in a Fifteen Year Follow-Up of 745 Nurses.** Theodore L. Badger and L. Fred Ayvazian. Am. Rev. Tuberc. **60:** 305–327, September 1949.

The authors report a clinical study of 71 cases of tuberculosis which developed in a group of 745 nurses, all of whom were free from the disease as far as could be determined when they entered training. The incidence of tuberculosis in initially negative tuberculin reactors was 11.0 per cent and in initially positive reactors 8.2 per cent. There were four deaths from tuberculosis, two in each group.

A series of illustrative cases is presented to bring out the authors' contention that there is no clear-cut clinical difference between "primary" tuberculosis in patients with a negative tuberculin reaction prior to the onset of the disease and "reinfection" tuberculosis in those with an initially positive reaction to tuberculin. The work of other authors regarding the pathology of the disease is cited. It shows that the pattern of healed primaries is the same for all age groups and may be present in pulmonary parenchyma with or without lymph node involvement. Furthermore, experimental work is cited which shows similar pathologic lesions and clinical course in animals subjected to a single artificial infection and in those subjected to "reinfection" tuberculosis. The inherent resistance of the animals was found to be the important factor in determining the course of the disease and the extent of the lesions produced.

The authors feel that this study bears out the theory that constitutional factors are more important than the development of allergy in determining the course and the type of tuberculosis. Fourteen per cent of the negative reactors went through training without becoming positive; perhaps these girls were endowed with enough resistance to destroy the tubercle bacillus before any type of significant lesion could be established.

The morbidity rate in this group of 745 nurses was 0.93 per 100 per year for all lesions, with a rate of 0.73 per 100 nurses for new pulmonary and pleural lesions needing treatment.

Two figures; eleven tables. JOHN H. JUHL, M.D.
University of Wisconsin

**Disposition and Follow-Up of Pulmonary Tuberculosis. A Study Based on the Character and Extent of the Lesion Seen on the Initial Roentgenogram.** Haynes Harold Fellows, John A. Evans, and Margaret G. Stephens. Am. Rev. Tuberc. **60:** 487–500, October 1949.

This report comes from the Metropolitan Life Insurance Company, which since 1928 has made a routine fluoroscopic study of the chest a part of the annual physical examination of all home office employees. As a result of a long-range study of a large number of cases of tuberculosis in this group, the authors believe that it is possible to predict the clinical course and outcome of the disease from the initial roentgen findings (*i.e.*, on a technically satisfactory 14 × 17-inch celluloid film).

The roentgenographic findings were analyzed independently by two of the authors, and in the case of difference of opinion, the final decision was reached by agreement. The extent of the pulmonary lesions was classified according to the National Tuberculosis Association classification. In addition, the lesions were classified as to their character: "inactive," "questionably active," and "active." On the basis of the combined classification, the disposition of the patient as well as the ultimate outcome of the disease can be determined with a fair degree of accuracy. The findings were also used to determine the insurability of the individual with pulmonary disease.

Although there are limitations to the use of roentgenography, the method is believed to be the best single piece of evidence in evaluating a case. The study also showed that pulmonary lesions which had been "inactive" for some time could, and sometimes did, become active; therefore, all patients with lesions which may be of tuberculous origin should have medical observation and periodic roentgenographic examinations throughout life. Statistical data in support of the above conclusions are given in a series of tables.

Six tables; 1 figure. JOHN H. JUHL, M.D.
University of Wisconsin

**An Appraisal of the Contribution of Mass Radiography in the Discovery of Pulmonary Tuberculosis.** Charlotte Silverman. Am. Rev. Tuberc. **60:** 466–482, October 1949.

An analysis of the experience of the Baltimore City Health Department with mass radiography of about 5 per cent of the population (48,175 apparently healthy persons from some 50 groups) is presented. The

examinations were done in the year 1946, and particular attention was paid to the number of cases of tuberculosis (of clinical and public health significance) discovered by this method which presumably would not have been discovered by other methods of case finding currently in use in that city. Chest photofluorography was the method of examination.

The results were somewhat disappointing, since out of 1,468 cases of pulmonary tuberculosis which came to official attention during the year, only 202 were classified as active minimal and only one-fourth of those were found as a result of the survey. In addition, a superficial investigation in the course of the study revealed that at least 10 per cent of the lesions found in the survey might have been found through other channels, such as study of "contacts," etc.

It is possible that future surveys should be directed toward groups in which the incidence of tuberculosis is high, such as adult Negro groups and adult groups living and working in the poorer sections of cities.

Eight tables. JOHN H. JUHL, M.D.
University of Wisconsin

**Routine Chest Photo-Roentgenography in Baroness Erlanger Hospital, Chattanooga, Tennessee.** Paul M. Colley. Am. Rev. Tuberc. **60:** 377–382, September 1949.

The results of routine photoroentgen chest examinations of all admissions to a general hospital in Chattanooga, Tenn., are compared with the results in two other surveys in the same area, one of which was conducted by the Health Department Clinic and one by a mobile unit. The tuberculosis incidence in 13,966 examinations at the Health Department Clinic was 2.7 per cent while for the mobile unit survey, covering 14,293 individuals, it was 2.0 per cent. In the survey of hospital admissions, the incidence was 3.7 per cent in a group of 5,187 patients. In the hospital group 92 per cent of the lesions were minimal, 7 per cent were moderately advanced, and 1 per cent far advanced. Minimal active lesions comprised 21 per cent of the total cases found.

A number of other similar surveys undertaken on routine admissions to general hospitals are cited by the author; the incidence of tuberculosis found is somewhat lower than that reported in this survey. In view of the findings in these surveys, it is felt that routine photoroentgenography of the chest should be undertaken in hospitals not only as a case-finding method but also as a measure to protect hospital personnel from needless exposure to tuberculosis.

One table. JOHN H. JUHL, M.D.
University of Wisconsin

**Miniature Chest Roentgenograms in Schools and Industries in San Antonio, Texas.** P. A. Pamplona and W. F. Hamilton. Am. Rev. Tuberc. **60:** 501–513, October 1949.

In a photofluorographic survey in the schools of San Antonio, Texas, 0.48 per cent of 8,983 students showed evidence of reinfection tuberculosis. The incidence in Mexican nationals or their descendants was 0.82 per cent, in the white group 0.29 per cent, and in the Negro group 0.27 per cent. In a group of 3,132 industrial workers in the same city the incidence was 2.3 per cent: in Mexicans 3.1 per cent, in whites 1.7 per cent, and in Negroes 1.5 per cent. The results emphasize the importance of tuberculosis in groups of relatively low economic status (the Mexican group) and in the adult groups as compared to the students.

Five charts; 5 tables. JOHN H. JUHL, M.D.
University of Wisconsin

**Pulmonary Tuberculosis in Children Treated with Streptomycin.** Eugene T. McEnery, Henry C. Sweany, and George C. Turner. Pediatrics **4:** 323–330, September 1949.

In a series of 21 cases of tuberculosis in children (18 progressive primary lesions and 3 cases of the adult type) clinical, roentgenologic, and bacteriologic studies showed the degree of therapeutic efficiency of streptomycin to be definitely related to the type and stage of the pulmonary lesion. Improvement occurred much more frequently in patients with early and acute disease processes than in those having late and chronic lesions.

The roentgen changes were slow in appearing. It was usually three months before any definite change could be observed. Improvement continued, however, eight months after discontinuance of treatment.

Twelve roentgenograms; 1 table.

**Abdominal Pneumocele Following Artificial Pneumoperitoneum.** H. C. Wortman and H. E. Bass. Am. Rev. Tuberc. **60:** 520–523, October 1949.

Two cases of abdominal pneumocele following artificial pneumoperitoneum for pulmonary tuberculosis are reported. The pneumoceles have the appearance of cystic gas-filled areas between the liver and diaphragm, and are due to anterior ballooning of the right coronary ligament. This space communicates with the general abdominal cavity through the epiploic foramen and actually represents an enlargement of the space known as the superior recess behind the liver, the uppermost portion of the omental bursa.

Four roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

**Chronic Histoplasmosis: A Common Cause of Pulmonary Calcification. Report of a Case with Superimposed Acute Pneumonitis.** Bernard D. Ross. South. M. J. **42:** 738–741, September 1949.

Not until three or four years ago was histoplasmosis considered as anything but a relatively rare disease. Much indirect evidence has now been accumulated, however, indicating that a benign subclinical form of this disease radiologically simulating tuberculosis is prevalent in certain parts of the United States, particularly the South Central States.

A case in a 12-year-old boy, a native of Indiana, is presented. The patient had definite signs of active pulmonary disease. Roentgen examination of the chest showed an area of dense infiltration and numerous scattered parenchymal calcifications. Routine films taken some four or five years earlier showed that some of the calcium had already been laid down at that time. The acute febrile phase lasted for several days, during which penicillin was administered, followed by rather sudden clinical improvement and disappearance of the infiltrative lesion. A tuberculin skin test was negative, but a histoplasmin test was positive, 1:1000. The rapid clearing of the infiltration in contrast to the rather slow-moving granulomatous tissue reaction of histoplasmosis and the fact that there was no accompanying deposition of calcium in this area led to the opinion

that the patient had had a superimposed pneumonitis, possibly of virus origin.

Three roentgenograms.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

**Primary Histoplasmosis with Recovery of Histoplasma Capsulatum from the Blood and Bronchial Secretions.** Ralph H. Kunstadter, Frances C. Whitcomb, and Albert Milzer. J. Lab. & Clin. Med. **34:** 1290–1297, September 1949.

A case of a primary histoplasmosis in a 12-year-old colored boy, who was followed from the appearance of the earliest symptoms, is presented. A large pulmonary infiltration in the left lung was observed on roentgenograms taken three days after the onset of symptoms and eighty days after the onset of the primary illness, which was postulated on the basis of a positive histoplasmin skin test. The hilar lymph nodes were enlarged bilaterally. Although the patient was asymptomatic eleven days after the appearance of the first symptoms, films of the chest showed only about 50 per cent clearing of the pneumonic process. Calcification of the pulmonary lesion was first noticed approximately four months after the appearance of the original infiltrate. There were minute areas of calcification in the left lung and bilaterally calcified hilar lymph nodes.

Six roentgenograms; 1 photograph; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

**Pneumonokoniosis on Western Australian Goldfields.** K. G. Outhred. M. J. Australia **2:** 355–358, Sept. 3, 1949.

A survey in the gold mining region centered about Kalgoorlie, Australia, in 1911, revealed pulmonary fibrosis in 22 per cent and active tuberculosis in 1.5 per cent of 1,805 miners examined. During the years 1925 and 1926 examination of 4,067 miners showed the presence of silicosis in 16 per cent, silicosis with tuberculosis in 3.3 per cent, and tuberculosis alone in 0.3 per cent. Repeated examinations of working miners, averaging 5,500 studies yearly, between the years 1927 and 1947 disclosed the development of 1,162 cases of silicosis, which represents an average annual incidence of 1 per cent of the men examined. In addition 539 cases of tuberculosis with pneumoconiosis and 169 cases of isolated tuberculosis were discovered, representing an average yearly incidence of 0.45 and 0.15 per cent respectively. Also during this period preemployment studies were conducted leading to a rejection rate varying between 5 and 15 per cent.

Preventive measures initiated about 1923 were found to have been instrumental in reducing by two-thirds the silicosis and tuberculosis rates, and in increasing by at least one-half the average length of time required for the development of silicosis in underground miners. In the past ten years more frequent examination of silicotic miners and ex-miners has demonstrated a decreasing incidence of complicating tuberculosis. At present it appears that usually the silicotic miner destined to become tuberculous becomes so later in life, after his working career.

The abnormal pulmonary roentgenographic findings in pneumoconiosis as seen in Western Australia are reticular accentuation and nodulation. The former usually, but not invariably, precedes the latter. Reticular accentuation, requiring an average of eight to ten years exposure, consists of a fine uniformly diffuse network of varying degrees of fibrosis within the lung parenchyma. In some instances fine mottling at the intersections of the linear network can be detected. Occasionally this process has been found to develop earlier and to be most marked within the mid-lung zones. Nodulation is similar in its distribution and uniformity to reticular accentuation, with occasional predominance in the upper halves or middle zones of the lungs. These nodular pulmonary changes require an average of sixteen to twenty years exposure for development.

The common complications encountered were tuberculosis and pneumonia, which are considered as superimposed infections, while bronchitis and emphysema are considered part and parcel of the pneumoconiosis. Complicating circulatory failure rarely occurred in the absence of arterial hypertension or other degenerative disease associated with nodular or massive fibrosis and emphysema.

The incidence and course of tuberculosis did not seem to vary from the normal in men with reticular accentuation. In nodular silicotics tuberculosis eventually developed in approximately 25 per cent. In such silicotics this infection was often noted to undergo periods of arrest, but in a majority, spreading consolidation and cavitation appeared later. A strong indication that tuberculosis would develop was the sudden appearance of nodulation or the development of "fluffy nodulations."

Resolution in complicating pneumonia was never complete, invariably leaving visible scarring. This residual fibrosis was thought to account for a majority of the stationary massive shadows observed.

Assessment of incapacity is somewhat difficult. Evaluation is based upon a summation of the roentgenographic changes and any clinically detectable complication. Most difficult of evaluation is the degree of aggravation of a non-industrial disease by a minor grade of pulmonary fibrosis.

R. R. SURRATT, M.D.
Baton Rouge, La.

**Haemosiderosis and Dust Reticulation of Coal Miners (An Interesting Case Report).** A Meiklejohn. Brit. J. Radiol. **22:** 547–548, September 1949.

A case is presented of a 43-year-old miner who had an obvious mitral stenosis with diffuse mottling of the lung fields which was gradually progressive. The roentgen appearance could have been due either to hemosiderosis or silicosis. Autopsy revealed both.

Two roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

**Systemic Blastomycosis.** David D. Feld and A. V. Cadden. Dis. of Chest **16:** 473–482, October 1949.

The authors report a series of 11 cases of systemic blastomycosis in patients admitted to the Muirdale Sanatorium (Wauwatosa, Wis.) for supposed tuberculosis between December 1934 and August 1948. In 2 of the patients both diseases were present.

Little is known of the sources of infection of blastomycosis or its mode of transmission. The disease manifests itself in two forms, the cutaneous and the systemic. The former is believed to be due to direct inoculation of the yeast-like etiologic organism, *Blasto-*

*myces dermatitides;* the respiratory tract is thought to be the portal of entry in the systemic type. The lungs have been found to show some degree of involvement in 95 per cent of the systemic cases. The microscopic picture resembles that of tuberculosis. Demonstration of the organism establishes the differentiation.

While the authors' cases were all of the systemic type, 8 showed secondary cutaneous manifestations. Symptoms common to all were cough, expectoration, hemoptysis, chest pain, loss of weight, chills, and fever. The roentgen findings vary from miliary lesions to dense masses. Five of the patients in the present series had upper lobe consolidations, and in one there was bronchogenic spread to the contralateral lung. Cavities were present in 2 cases. The chest roentgenograms and short histories of the 11 cases are included.

HENRY K. TAYLOR, M.D.
New York, N. Y.

**Transient Recurring Atypical Pulmonary Infiltrates with Delayed Eosinophilia, Associated with Ascaris and Trichocephalus Infestation.** J. Le Melletier, J. Lemoine, and Franchet. J. franç. de méd. et chir. thorac. **3:** 322–326, 1949. (In French)

A 37-year-old nurse suffered three episodes of cough, chest pain, fever, and dysphonia during a period of two months. Chest roentgenograms obtained on the three occasions showed areas of low-grade pneumonitis, occurring in different parts of the lungs with each attack. Two blood counts during this period were of no pathognomonic value. The sputum and gastric washings were constantly negative for tuberculosis. Four months later there was another recurrence of dysphonia. A chest roentgenogram at this time was negative, but the blood count revealed 16 per cent eosinophils and this led to examination of the stools, in which *Ascaris* and *Trichocephalus* eggs were identified. Following administration of a vermifuge, an adult *Ascaris* worm was expelled.

This case differs from the usual course of Loeffler's syndrome in which *Ascaris* infestation has been found to be the most common etiologic factor. The eosinophilia usually occurs while the pulmonary infiltrate is present, but in the present instance the alteration in the blood count was found four months later and was not accompanied by any pulmonary lesion.

Three roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

**Surgical Lesions of Pulmonary Coccidioidomycosis.** S. J. Greer and John B. Grow. Dis. of Chest **16:** 336–350, September 1949.

Coccidioidomycosis is a highly infectious disease caused by the diphasic fungus *Coccidioides immitis*. It occurs in a primary form as an acute benign respiratory infection, and in a progressive form characterized by widespread dissemination to the skin, subcutaneous tissues, viscera, bones, and other tissues. Recovery from the acute benign form is rapid. Dissemination occurs in about 1 per cent of the primary infections, and about half of these terminate fatally. The most common complication of the pulmonary lesion is cavity formation, which occurs in some 4 to 6 per cent of the acute cases. Cavitation persists after the acute phase of the disease has passed; it is usually asymptomatic and most of the cavities close in three to six months.

The authors give the case histories of 10 patients who underwent surgery because of unusual complications following primary pulmonary coccidioidomycosis. Six had lobectomies performed. Of these, 5 were done because of persistent cavitation, and one for a coccidioidoma. The four decortications were performed because of a non-expansile lung following spontaneous pneumothorax.

Seven roentgenograms; 2 photographs.

HENRY K. TAYLOR, M.D.
New York, N. Y.

**Pulmonary Cryptococcosis. Report of a Case with Surgical Cure.** Gregory F. Froio and Charles P. Bailey. Dis. of Chest **16:** 354–359, September 1949.

Torulosis, or cryptococcosis, due to *Cryptococcus neoformans*, is a chronic disease affecting the lungs, central nervous system, and lymph nodes. The authors report a case in which a lesion was detected in the lower lobe of the right lung during a routine examination for Army induction. After various tests had ruled out tuberculosis, a diagnosis of lung tumor was made, probably bronchogenic carcinoma. There were no significant clinical or physical findings. The roentgen examination revealed a large mass in the right lower lobe. A right pneumonectomy was performed five months after the lesion was detected, and at the time of the report, five years and seven months later, the patient was well, with no complaints.

Microscopic examination disclosed a granulomatous lesion exhibiting areas of fibroblastic proliferation and lymphocytic infiltration resulting in a typical tubercle pattern, many of which contained foreign-body giant cells. There was no caseation. Many of the giant cells contained vacuoles. Scattered throughout the lesion were large capsular spaces containing small, round, refractile bodies suggestive of a fungous disease. Dr. Roger D. Baker, of Duke University, reviewed the material and concluded that "the diagnosis of cryptococcosis is reasonably secure on the histopathologic study without culture in this case."

The fungus gains entrance through the respiratory tract, but pulmonary cryptococcosis without meningeal involvement is unusual. The disease is highly fatal, but it is suggested that if the lesion is local and can be diagnosed and removed before meningeal spread has occurred, the patient may be cured. It is recommended that pulmonary lesions from which no tubercle bacilli can be isolated, be carefully studied for fungi.

HENRY K. TAYLOR, M.D.
New York, N. Y.

**Non-Occupational Berylliosis.** Merril Eisenbud, R. C. Wanta, Cyril Dustan, L. T. Steadman, W. B. Harris, and B. S. Wolf. J. Indust. Hyg. & Toxicol. **31:** 282–294, September 1949.

An intensive study of contamination of the atmosphere in the vicinity of a beryllium-producing plant, including an x-ray survey, revealed 11 persons with chronic beryllium poisoning (berylliosis). None gave a history of occupational exposure to beryllium. Ten of the affected persons resided within three-quarters of a mile of the plant. The distribution of the cases with respect to the plant indicates that the incidence of disease was a function of the concentration to which the residents were exposed.

The eleventh patient resided almost two miles from the plant and was a member of the household of an

employee. This patient's disease is believed to have resulted from atmospheric contamination introduced into the household by work clothes. Based on air analyses made during simulated home cleaning of work clothes, a daily laundering can result in the inhalation of 17 micrograms of beryllium.

The average daily concentrations of beryllium in the vicinity of a plant producing and processing beryllium should be limited to 0.01 microgram per cubic meter. There is no justification for applying these data as criteria in judging the hazard of exposed workers in the beryllium industry.

Five charts; 7 tables.

**Acute Diffuse Interstitial Fibrosis of the Lung.** J. A. Weaver, Jr. Rocky Mt. M. J. **46:** 751–754, September 1949.

The author presents the case of a 72-year-old farmer with typical evidence of advanced pulmonary disease, increasing right heart embarrassment, and eventual cardiac failure. The most distressing symptoms were cough and dyspnea. There was almost total lack of physical pulmonary evidence despite rather extensive fibrosis described radiographically.

The autopsy findings consisted predominantly of an extensive, diffuse, progressive interstitial fibrosis, with slight necrosis of alveolar epithelium, marked thickening of the alveolar walls, and eosinophils in the interstitial tissue. There was no hyalinization and relatively little edema.

Radiographically the chest films were reported as disclosing extensive mottling throughout all lobes of both lungs, resembling a miliary tuberculosis. The roentgenologist offered as possible diagnoses: silicosis, fungous infection, syphilitic peribronchitis, a bizarre fibrosis from passive congestion, bilateral bronchopneumonia, periarteritis nodosa, and Boeck's sarcoid.

The author concludes that the case represents a condition described by Hamman and Rich (Bull. Johns Hopkins Hosp. **74:** 177, 1944. Abst. in Radiology **43:** 405, 1944) as acute diffuse interstitial fibrosis of the lung. He discusses the rather obscure origin of the condition and points out that it should not be confused with "lung failure," which is a gradual failure of pulmonary elasticity with advancing age, complicating interstitial edema, slowly progressing emphysema, etc.

E. S. KEREKES, M.D.
University of Arkansas

**Chronic Pulmonary Granulomatosis. Report of Ten Cases.** J. M. DeNardi, H. S. Van Ordstrand, and M. G. Carmody. Am. J. Med. **7:** 345–355, September 1949.

Chronic pulmonary granulomatosis is a well defined syndrome. There is a cough of insidious onset, becoming more pronounced and severe, associated with substernal pain and discomfort. Exertional dyspnea appears and becomes troublesome. Acrocyanosis and clubbing of the fingers are present in the later stages. Chest expansion is limited and vital capacity diminished. Fine crackling râles are heard in the more advanced stage. Chest roentgenograms reveal a ground-glass appearance, with minute nodules throughout the lungs. Treatment consists of limiting the patient's activities and avoiding respiratory infections. Prognosis is doubtful.

Two of the 10 cases reported by the authors came to autopsy. Histologically, in the lungs, the alveolar walls were irregularly thickened by infiltration of lymphocytes and focal accumulation of histiocytes and foreign-body giant cells. Hence the name granulomatosis.

It is of peculiar interest that all of the authors' 10 patients had some contact with a beryllium plant, although in most instances exposure to the metal or its compounds seemed to have been evanescent or indirect. However, chemical agents appear to play a significant part in the causation of this disease.

Six roentgenograms; 4 photomicrographs.

PAUL W. ROMAN, M.D.
Baltimore, Md.

**Pulmonary Adenomatosis.** Sylvia Bubis and James H. Erwin. Am. J. Med. **7:** 336–344, September 1949.

Many aspects of pulmonary adenomatosis are reviewed in this article, and 2 new cases are reported. This is a rare fatal disease of the lungs, characterized by hyperplasia and metaplasia of the alveolar epithelium into tall columnar mucus-producing glandular tissue. There is progressive involvement of both lungs, the replacement of the respiratory surfaces resulting in death by asphyxia. The authors describe the similarity of the histologic findings to those in sheep and other animals.

The etiology remains obscure. A possible explanation is failure of normal development of the fetal pulmonary epithelium. Another suggestion is that abnormal proliferation of the lung results from such stimuli as infections and chemical and physical agents. A third possibility, that of a virus infection, is based on finding adenomatosis in mice infected with influenza virus. Some investigators consider the disease neoplastic and report regional, brain, and bone metastases.

The patient has a prolonged history of cough and copious mucoid sputum. There are bouts of respiratory infection, weight loss, weakness, and finally severe dyspnea and cyanosis. Roentgenograms show an increasing diffuse conglomerate pneumonic infiltration.

One photomicrograph; 1 table, summarizing observations in 19 cases previously recorded in the literature.

PAUL W. ROMAN, M.D.
Baltimore, Md.

**Carcinoma of the Lung.** J. S. Fulton. Proc. Roy. Soc. Med. **42:** 775–782, October 1949.

This article is based upon statistics from the Liverpool Region, Great Britain, with regard to pulmonary carcinoma. It covers 1,610 cases recorded over a five-year period (1944–48). The figures tend to reveal that:

1. Carcinoma of the lung has shown a markedly increased incidence in recent years.
2. Carcinoma of the lung is more prevalent in industrial areas than in rural zones.
3. The maximum number of cases are recorded in the sixth decade.
4. The disease occurs seven times as often in men as it does in women.
5. Tobacco is an etiological factor of possible statistical significance.
6. Involvement of the right lung is a little commoner than of the left lung.
7. The probable mean duration of symptoms is

between two and three months before the patient presents himself for examination.

8. Seventy per cent of patients already had extensive disease when first seen.

9. Metastasis occurs most commonly to lymph nodes, liver, osseous system, and brain.

10. Patients with inoperable disease given radical x-ray therapy live twice as long as those untreated (fourteen months as compared with seven months).

The author deals briefly with the indications and contraindications for radical or palliative treatment of the disease and its metastases.

Fifteen tables.

EDWARD E. LEVINE, M.D.
Dearborn, Mich.

**Tumors of the Mediastinum. A Discussion of Diagnostic Procedure and Surgical Treatment Based on Experience with Forty-four Operated Cases.** Lyman A. Brewer, III, and Frank S. Dolley. Am. Rev. Tuberc. **60:** 419–438, October 1949.

The present study is based on a large series of mediastinal tumors, 44 of which were treated surgically. The symptomatology tends to appear late in many cases, with a mass of considerable size producing few signs or symptoms. A vague intrathoracic ache, discomfort, or sense of fullness is often the first evidence of disease, with intercostal or pleural pain, sometimes severe, in neurogenic tumors. Horner's syndrome, recurrent laryngeal paralysis, and phrenic nerve irritation or paralysis occur late and usually in malignant tumors. Dry cough may be an early symptom, with production of sputum later. Hemoptysis occurs in 20 per cent of all mediastinal tumors. Wheezing, stridor and dyspnea, dysphagia due to esophageal pressure, fever, weight loss, anemia, and other general symptoms may be observed. Vascular obstruction is usually indicative of a malignant lesion.

Roentgen examination of the chest is the most important single aid for the identification of a mediastinal tumor. Lateral and oblique views, fluoroscopy, kymography, laminagraphy, and bronchography may be indicated, in addition to the usual frontal projection. Bronchoscopy is of value in excluding endobronchial tumor and esophagoscopy is occasionally useful. The authors feel that needle aspiration of tumor cells is justified only when there is a question of localized fluid or when a tumor, if malignant, is obviously inoperable. Skin testing for various specific granulomata is often indicated. A therapeutic trial of x-rays is important in possible cases of mediastinal Hodgkin's disease and lymphosarcoma. Decrease in the size of the tumor with an average skin dose of 750 to 1,000 r usually means one of these diseases and is a contraindication to surgery. Prolonged irradiation is not indicated if the mass does not respond quickly. Biopsy of available peripheral nodes is always indicated. Surgical exploration is the final diagnostic step.

The location of the tumor is of diagnostic value. Teratoid, thyroid, thymic, and pericardial cysts or tumors are anterior; neurogenic tumors are usually posterior, with tuberculous nodes, metastatic and lymphoid tumors, and bronchogenic and gastric cysts often central in location. In the present series (operated) neurogenic tumors were the most common, with teratoid tumors and cysts (bronchogenic and pericardial) second and third in order of occurrence.

When a differentiation between benign and malignant tumor can be made, the former should be surgically removed, since malignant degeneration may occur. The risk of operation is slight and the percentage of cures is high. When x-ray therapy is used as a diagnostic test and the tumor does not shrink promptly, surgery should be undertaken. The lymphoid tumors respond to irradiation but other malignant growths usually do not and the chance of cure is slight, since they are usually inoperable.

Ten roentgenograms; 4 tables; 3 diagrams.

JOHN H. JUHL, M.D.
University of Wisconsin

**Mediastinal Emphysema and Pneumothorax Following Thyroidectomy. Report of Two Cases.** Lindon Seed. J. Clin. Endocrinol. **9:** 987–998, October 1949.

Sixteen cases of mediastinal emphysema with pneumothorax and, in most instances, subcutaneous emphysema, following thyroidectomy, have been reported in the literature, with 11 deaths. The author adds 2 cases, with recovery in both after aspiration of air from the thoracic cavity.

This postoperative complication is not peculiar to thyroidectomy, being seen much more frequently following tracheotomy for obstructive dyspnea. It is probably the result of rupture of an intrapulmonary vesicle with passage of air along the vascular sheaths through the root of the lung into the mediastinum and thence into the pleural cavity and the subcutaneous tissues of the neck.

This condition usually arises during the operation or a few hours afterward. Rapid breathing with a prolonged expiratory phase and cyanosis commonly are present. Subcutaneous emphysema may be the first sign. Death usually is due to a tension pneumothorax.

A roentgenogram of the chest readily establishes the diagnosis of pneumothorax, but the diagnosis of mediastinal emphysema is more difficult. Air causes a widening of the mediastinal shadow and linear areas of radiolucency paralleling its borders. The author believes that a lateral film is superior to a posterior-anterior projection for diagnostic purposes.

Two roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

**Lateral Intrathoracic Meningocele.** Glen O. Cross, James R. Reavis, and William W. Saunders. J. Neurosurg. **6:** 423–432, September 1949.

Nine cases of lateral intrathoracic meningocele have been reported in the literature. Six of these have been in patients having associated neurofibromatosis.

The authors report the case of a patient whose main complaint was pain at the level of the inferior aspect of the right scapula radiating around the trunk to the right costal margin. Physical examination revealed subcutaneous neurofibromata and *café au lait* spots on the skin. There was a moderate kyphosis of the thoracolumbar spine. An area of hypalgesia and hypesthesia on the right, of segments corresponding to T-7 and T-11, was found. Roentgen examination revealed a soft-tissue lesion expanding the thoracic and upper lumbar neural arches and intervertebral foramina, with disruption of the pedicles of T-10 and T-8. There was pressure erosion of the dorsa of bodies, with subluxation and rotation of T-10. The soft-tissue mass projected into the right lower lung field. Pantopaque and air myelography demonstrated the

cystic nature of this mass and its communication with the subarachnoid space.

Four roentgenograms; 4 drawings; 2 photographs.

HOWARD L. STEINBACH, M.D.
Universisy of California

**Calcified Ductus Botalli Persistens.** O. W. Husebye. Acta radiol. **32:** 173–176, Sept. 30, 1949.

Ductus Botalli persistens, or patent ductus arteriosus, presents as its classic and characteristic roentgen findings: (1) hypertrophy of the heart, (2) large left ventricle, (3) dilation of the left atrium, (4) protuberant pulmonary conus, (5) increased vascular markings in the hilus and lungs, together with a large aortic arch, (6) hilar dance. The author reviews the altered circulation in this anomaly and points out its part in production of the classic signs. Not all of these need be present in a single case.

A case of clinically diagnosed patent ductus arteriosus is presented in which calcification of the ductus was evident on a routine chest film. The calcification was also shown on special views and a planigram. The author states that calcification of a patent ductus arteriosus has been seen postmortem but has rarely been described roentgenographically.

Four roentgenograms.

P. B. LOCKHART, M.D.
Indiana University

## THE DIGESTIVE SYSTEM

**Gastro-intestinal Gas. Observations on Belching During Anesthesia, Operations and Pyelography; and Rapid Passage of Gas.** Walter G. Maddock, John L. Bell, and Myron J. Tremaine. Ann. Surg. **130:** 512–535, September 1949.

Normally the superior esophageal sphincter keeps the esophagus closed. With swallowing movements, the sphincter relaxes and air enters with fluid and food. In the upright position the air collects at the top of the stomach, and when more than the usual amount accumulates, as with a meal, it is belched up. Frequent belching is a modification of air sucking or aerophagy. The individual who can repeatedly belch on request knows how to relax the superior esophageal sphincter, does so, and then tries to breathe in with the glottis closed. The air thus entering the esophagus is immediately belched back.

Five normal male subjects who could belch at will were studied, and it was found that the amount of air aspirated into the esophagus was greater than the amount eructated. In the upright position the air is trapped in the cardia and nothing more disturbing than further eructations result, but with a patient lying in bed, the air may pass on and cause trouble.

Twenty-three patients undergoing anesthesia and operation were found to swallow infrequently, and little gas was aspirated from the stomachs of the majority studied. One patient, breathing against a partially obstructed airway, took in a large amount of air during operation. This was essentially inspiring against a closed glottis and some relaxation of the superior esophageal sphincter by the anesthetic probably played a part. Considerable gas was aspirated from the stomachs of five patients during operation under cyclopropane anesthesia plus curare. Each was considered to have a partial paralysis of the respiratory muscles due to the curare, and positive pressure anesthesia was used. With curare, the superior esophageal sphincter was probably well relaxed and the positive pressure forced gas into the stomach. A rare case of massive, spontaneous pneumoperitoneum resulting from perforation of the stomach which became tremendously dilated during a minor operation under sodium pentothal anesthesia is reported. Those in the operating room heard the air entering the esophagus with each inspiration.

Air was found to pass very rapidly through the gastro-intestinal tract. Air aspirated into the stomachs of experimental subjects reached the cecum in an average of 14.6 minutes and was passed as flatus in thirty minutes. It is evident that the gas seen in the intestines on a roentgenogram may be largely atmospheric air which was aspirated esophageally a few minutes previously.

By continuous gastric suction, considerable air was aspirated from the stomachs of patients undergoing pyelography. When these patients' stomachs were kept empty, no increase in intestinal gas occurred. This is evidence that external air is a major source of gastro-intestinal gas. Nervous patients undergoing pyelography had three times as much air aspirated from their stomachs as the calmer patients.

The authors conclude that there is every reason to believe that patients under many conditions become temporary aerophagics. The stimulus may be entirely nervous without organic origin, or be associated with an organic disease or injury and its treatment.

Twenty-one roentgenograms; 4 charts; 4 tables.

WILLIAM H. SMITH, M.D.
Louisville, Ky.

**Spontaneous Perforation of the Esophagus. Report of Three Cases Successfully Treated Surgically.** Joseph P. Lynch. New England J. Med. **241:** 395–400, Sept. 15, 1949.

Spontaneous perforation of the esophagus has been considered a rare condition, but recently there has been an increase in the number of cases reported. The advance in thoracic surgery together with the development of antibiotics has increased the possibility of successful treatment following early diagnosis.

The typical history of severe vomiting, followed by excruciating chest or abdominal pain, shock, low blood pressure, rapid pulse, and subnormal temperature, together with the radiographic findings of air in the mediastinum or in the soft tissue of the neck, should be sufficient to make a definite diagnosis of spontaneous rupture of the esophagus.

If these patients are untreated, the course is rapidly and progressively downhill, with death in about forty-eight hours. Prompt surgical repair of the rupture should lead to recovery.

The author presents 3 complete case reports. The first patient was seen rather late in the course of his disease and was treated conservatively, since a major surgical procedure seemed to be contraindicated by the general condition. However, the chest and mediastinum were drained. With antibiotic therapy, recovery eventually ensued after a lengthy and stormy course. In 2 other cases the diagnosis was made at an earlier hour. Primary closure of the esophagus and drainage of the pleural space resulted in prompt return to normal health.

Six roentgenograms.

JOHN B. MCANENY, M.D.
Johnstown, Penna.

**Megaesophagus Visible on a Plain Film with Agenesis of the Left First Rib and Left Sided Bronchiectasis.** J.-M. Lemoine. J. franç. de méd. et chir. thorac. **3:** 340–343, 1949. (In French)

A 29-year-old male had experienced digestive troubles since birth, consisting chiefly of dysphagia and regurgitation of food. Roentgenograms of the chest obtained at intervals during a ten-year period consistently revealed a clear zone in the upper mediastinum following a straight sharply delimited vertical line to the left of the trachea. A similar appearance has been previously reported as due to megaesophagus. Tomograms, without contrast medium, localized the translucency in the posterior upper mediastinum, and barium studies proved the shadow to represent a gas-containing dilated esophagus. All films revealed in addition a complete agenesis of the left first rib.

The patient was also afflicted with recurring respiratory infections, which were thought to be due to aspiration of regurgitated esophageal contents. During the last five years of observation these eventually resolved into a chronic bronchiectasis of both lobes of the left lung, proved bronchoscopically and bronchographically. The pulmonary disorder was believed to be acquired, secondary to the congenital megaesophagus; the costal anomaly, of course, was congenital.

Four roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

**Roentgenologic Diagnosis of Gastric Cancer.** B. R. Kirklin. Wisconsin M. J. **48:** 811–814, September 1949.

Practically all gastric cancers can be revealed by roentgenologic examination, provided the technic is carefully executed and includes roentgenoscopic inspection of the gastric internal relief as depicted by a thin coating of the suspension of barium. Specific identification of the lesion as malignant will be less accurate, for this will depend partly on its shape, size, and situation.

Cancers may appear as tumors or ulcers, with many gradations of ulcerating tumors between. The factors of tumefaction and ulceration are materially affected by the histopathologic aspects of the growth. Scirrhous cancer infiltrates the gastric wall, but in most instances tumefaction is not pronounced and ulceration, although extensive, is not deep. As a rule, the soft, or medullary, or mucoid cancers are both markedly tumefactive and deeply ulcerative.

All varieties of gastric cancer have certain common physical signs and secondary roentgenologic manifestations. When a tumor corresponding to a shadow defect is palpable, the presumption is strong that it is malignant. Almost invariably, gastric motility is either accelerated or retarded. If the growth is not obstructive, the gastric contents leave the stomach almost continuously and it is soon emptied. But in approximately half of the cases the cancer is obstructive, emptying is retarded, and the stomach may be dilated.

In evaluating the actual and potential signs of cancer, the examiner must first of all determine whether direct and primary signs, such as shadow defects, luminal distortions and deformities, are produced by a gastric lesion or by extrinsic causes, such as food, foreign bodies in the stomach, pressure against the spinal column, strong retraction of the abdominal wall, gastrospasm, ascites, abdominal neoplasms, or pregnancy. Alterations of the luminal contour and topography produced by cancer are permanent as to configuration and situation at repeated examinations, and cannot be effaced by manipulation, whereas the simulants have none of these characteristics. The indirect manifestations, the secondary and functional phenomena, may sharpen the examiner's observation and impel him to search for direct evidence that is not immediately obvious, or they may have some corroborative weight when direct signs are present, but secondary signs alone never constitute a safe basis for diagnosis.

In the differential diagnosis of advanced cancer, diaphragmatic hernia of the stomach, bezoar, gastric syphilis, and benign tumor may require consideration. Tumefactive gastric syphilis cannot be distinguished from scirrhous cancer, but is so rare that its potential existence can be ignored. The benign tumors, which are chiefly single or multiple fibromas, myomas, or adenomas, usually are smoothly ovoid, polypoid growths, and are not hard to recognize. It must be emphasized that all such tumors are potentially malignant, and in most instances careful microscopic examination will reveal malignant cells in some part of the growth, so that to make a diagnosis of benign tumor, without qualification, is to perform a disservice to all concerned.

Cancer of the cardia requires special consideration, because this region cannot be palpated or manipulated. Usually, a shadow of the tumor is visible in the normally transparent gas bubble, and is often first seen in roentgenograms of the thorax. Details of the tumor relief can be exhibited by pressure on the lower portion of the stomach to force the barium suspension upward and coat the surface of the growth. Enlarged lymph nodes sometimes deform the internal border of the dome, and occasionally the shadow of the apex of the heart is seen in the bubble, but if the examiner keeps these facts in mind he is not likely to attribute either manifestation to cancer.

Many of the small and probably early cancers of varying morphology are hard to diagnose specifically as malignant, although few should escape roentgenologic observation unless they are seated near the pylorus. Rarely, small mucoid cancers are smoothly rounded tumors without ulceration and are indistinguishable from the so-called benign fibroadenomas. In such instances the examiner should stress the probable malignancy of the lesion.

One of the small cancers that can be identified with confidence is an ulcerous tumor, in which the floor of the ulcer is largely or completely internal to the plane of the normal mucosal surface, and the crater is surrounded by an elevated border. When the lesion is situated on the posterior wall, the raised border appears under pressure as a translucent radiant halo around the barium-filled crater. When it is situated on the lesser curvature, it may be possible, by the exertion of pressure, to separate the shadow of the crater from that of the filled stomach, and the crater shadow may assume the form of a concave-convex or biconcave lens, or meniscus.

Malignant ulcers are ulcerous cancers that take the form of ulcers without evidence of tumefaction, and their malignancy can be inferred only from other indications. By experience it has been found that large ulcers, those whose diameter exceeds 2.5 cm., are usually but not always malignant. About 10 per cent

of gastric ulcers that present no roentgen signs of malignancy prove nevertheless to be cancerous.

Small cancers of any variety situated near the pylorus are extremely difficult to diagnose specifically. They cause narrowing and apparent elongation of the prepyloric segment of the stomach, but such manifestations also may be produced by hypertrophy of the antral rugae, hypertrophy of the pyloric muscle, duodenal ulcer, and benign gastric ulcer with spasm. Hypertrophic rugae usually can be identified by their orderly arrangement, and hypertrophy of the pyloric ring by the resulting invagination of the bulbar base. In some cases of duodenal ulcer with narrowing of the bulb, the site of the pylorus is not evident, and the examiner is uncertain as to whether the narrowing is prepyloric or postpyloric. When the canalized segment is obviously prepyloric and the canal is tortuous, the lesion probably is malignant.

Seven roentgenograms; 1 photograph.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

**An Attempt to Identify Likely Precursor Groups of Gastric Cancer.** David State, David Gaviser, Thomas B. Hubbard, Jr., and Owen H. Wangensteen. J. Nat. Cancer Inst. **10:** 443–453, October 1949.

A co-operative clinical study embracing the Departments of Pathology, Radiology, Medicine, and Surgery was begun at the University of Minnesota Hospitals in July 1945, in an effort to uncover early silent gastric carcinoma.

The following groups were considered to be potential harborers of silent gastric carcinoma and were studied by roentgenography and in some instances by gastroscopy. All were made up of outpatients beyond the age of fifty, free of digestive complaints: (1) patients with achlorhydria and hypochlorhydria; (2) patients with pernicious anemia; (3) individuals with a positive family history of gastric carcinoma (relatives of patients who had been operated upon at the University Hospital for gastric carcinoma); (4) patients with occult blood in the stool and/or hemoglobin values of 11.0 gm. or less.

There were 4,048 outpatients in the proper age group, and gastric analysis was done on 3,416 of these, after one to three doses of histamine; 1,201 were found to be achlorhydric or hypochlorhydric. To this number were added 110 patients studied by Wetherby in 1940. The accompanying table summarizes the findings on x-ray study for all groups:

Of the 8 carcinomas in the achlorhydric group, 5 were early, well localized, and without metastases. The remaining 3 were farther advanced and had lymph node metastasis.

Thirty-eight cases of gastric polyps were discovered in this study. In addition, the case records of 47 other patients with gastric polyps were reviewed. To date, 31 of these 85 patients with gastric polyps have been operated upon and in 7 instances the polyps were found to be malignant.

A discussion of the organizational set-up and findings of the Cancer Detection Center of the University of Minnesota is appended.

Four tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

GASTRIC CANCER PRECURSOR STUDY, JULY 1, 1945 TO NOV. 1, 1948

| Individuals | | | Findings | |
|---|---|---|---|---|
| Type | Number | G.I. Series | Polyps | Cancer |
| Achlorhydrics | 1,049 | 1,381 | 27* | 7† |
| Hypochlorhydrics | 152 | 93 | 1 | |
| Wetherby achlorhydrics‡ | 110 | 165 | 6§ | 1 |
| Pernicious anemia patients | 92 | 186 | 4§ | 3 |
| Relatives of patients with gastric cancer | 75 | 75 | | |
| Patients with hemoglobin level of 11 gm. or less | 54 | 54 | | |
| Precursors with occult blood in feces | 46 | 34 | | |
| Total | 1,578 | 1,988 | 38 | 11 |

* Plus 14 questionable.

† Two additional carcinomas missed through organizational errors; 1 additional carcinoma missed through misinterpretation.

‡ Achlorhydric patients studied by Wetherby in 1940.

§ Plus 1 questionable.

Of the patients studied, 2,177 (87.1 per cent) were forty or more years of age; 70 per cent were of the white race and the sex distribution was about equal. Satisfactory examinations were obtained in 2,350 (94 per cent); 86.9 per cent were normal and 7.1 per cent abnormal.

The customary gastro-intestinal fluoroscopic and radiographic examination was adopted as a standard of comparison for this study. All patients who demonstrated any abnormality or a suspicion of abnormality in their photofluorographic examinations were asked to return for regular radiologic studies. A total of 280 patients were studied in this way: 61.5 per

**Photofluorography in the Detection of Gastric Cancer.** John F. Roach, Robert D. Sloan, and Russell H. Morgan. J. Nat. Cancer Inst. **10:** 455–458, October 1949.

The authors present the results in the first 2,500 cases studied by a photofluorographic method of examining the stomach, in an attempt to detect early carcinoma. The statistical background and the instrumentation necessary for this study have been described previously in some detail (Am. J. Roentgenol. **61:** 183, 1949. Abst. in Radiology **54:** 140, 1950).

cent were found normal on both regular and photofluorographic examination; 2.1 per cent were found to be abnormal on the regular examination but normal on the photofluorographic examination; 14.2 per cent were found abnormal on both examinations; 22.2 per cent were abnormal on the photofluorographic but normal on the regular examination.

Of the 40 patients who were abnormal on both the photofluorographic and regular study 13 had proved gastric cancer and 5 roentgen evidence of malignant growth but as yet no microscopic proof. The remaining 22 cases represented benign lesions, including 5 cases of gastric ulcer and 11 cases of hiatus hernia. Three of the 18 patients with suspected or proved gastric cancer were absolutely free of any symptoms.

Five tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

**Hidden Gastroduodenal Lesions.** Roland P. Reynolds and Meyer O. Cantor. Gastroenterology **13:** 280–284, October 1949.

Radiologists will recognize the vast majority of gastroduodenal lesions with remarkable accuracy, but there is a small group that are beyond the diagnostic horizon of the most skillful. For this reason, x-ray examination should be used as a laboratory procedure to corroborate or disprove clinical observations. The radiologist, for instance, may report non-visualization of the gallbladder and negative findings relative to the stomach and duodenum, and yet on operation the surgeon may find a normal gallbladder and an ulcer at the pylorus. This type of case may be diagnosed by judicious attention to the clinical history, after having been missed radiologically.

On the other hand the radiologist may report a lesion where clinical findings have given no hint of its existence; this is particularly true of early cancer. Close co-operation between the radiologist, clinician, and surgeon will help to avoid many errors.

Even with the abdomen open, the surgeon may fail to make a diagnosis of a gastroduodenal lesion. This is particularly true in patients operated upon for the second or third time, where the area is so covered by adhesions that the true lesion may be masked.

The author cites four cases to illustrate his points. The first was that of a white female, age 38, who was admitted to the hospital with pain in the right upper quadrant. It came on intermittently over a period of eight years, and on two occasions the stools were clay-colored. Cholecystograms revealed a non-functioning gallbladder with a stone in the cystic duct. The patient had been treated for a stomach ulcer nineteen years before and the x-ray examination revealed what was thought to be an old ulcer scar. On operation a normal gallbladder was found to be firmly adherent to the pylorus, which was the site of a large penetrating ulcer.

The second patient was a 51-year-old woman who complained of cramp-like pains in the epigastrium, radiating to the back. Three roentgenograms showed a prepyloric lesion. On operation, the stomach was found to be pulled downward by a mass of adhesions. The patient did poorly postoperatively and a second operation was performed in which the lower portion of the stomach was resected. The resected tissue showed a large ulcer and a gastritis. The author believes that it would have been good judgment to have opened the stomach at the time of the first operation.

Case No. 3 was that of a 43-year-old woman who complained of pain in the epigastrium coming on about two hours after meals. Roentgenograms and test meals were negative for ulcer, and medication gave no relief. Operation revealed an active duodenal ulcer.

The final case is that of a 41-year-old white woman who had experienced vomiting spells at intervals for the past nine years. These episodes would last for as long as a month. Four radiological examinations had been done during that time, all of which were negative. A Levin tube was passed and kept functioning for five days, at the end of which time a larger ulcer of the pylorus was demonstrated by x-ray examination. At operation this was found to penetrate into the pancreas. A large mucous plug had filled the ulcer crater and prevented an x-ray diagnosis until it was removed.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

**Significance of an Ulcerating Lesion in the Stomach Following Gastroenterostomy.** Howard K. Gray and Karl A. Lofgren. Surg., Gynec. & Obst. **89:** 285–291, September 1949.

In the ten-year period from 1938 through 1947, 845 patients with previously established gastro-enterostomies for duodenal or gastric ulcers requiring reoperation were seen at the Mayo Clinic. In 41 patients originally operated upon for duodenal ulcer, gastric lesions developed after the original gastro-enterostomy. The second operation revealed 11 (27 per cent) of the gastric lesions to be malignant and 30 (73 per cent) to be benign gastric ulcers. The average time between the two operations was thirteen years for the benign gastric lesions and fifteen years for the cancers.

Eleven gastric lesions were found after a previous gastro-enterostomy for gastric ulcer. On operation 6 (55 per cent) proved to be malignant and 5 (45 per cent) benign. An average interval of seventeen years occurred between the two operations in the patients found to have benign gastric lesions. Five of the 6 patients with malignant lesions were found to have carcinoma within two years of the gastro-enterostomy. The fact that neither biopsy nor excision of the original gastric ulcer had been done in any of these cases suggests that the lesion was probably malignant at the time of the first operation.

Differential diagnosis is very difficult in these cases. The symptoms often suggest benign peptic ulcer. The roentgenographic findings are difficult to interpret owing to the marked structural changes, inflammatory conditions, and obstructive features that are so often encountered. An accurate roentgenographic diagnosis has been found to be almost impossible when the new lesion has developed in the portion of the stomach distal to the old gastro-enteric stoma.

The importance of suspecting and ruling out carcinoma before any conservative management is instituted is emphasized.

Two illustrations; 3 tables.

HUGH P. SMITH, JR., M.D.
University of Pennsylvania

**Ulcer of the Pyloric Ring. Report of Twenty Cases.** George A. Boylston. Arch. Int. Med. **84:** 532–539, October 1949.

Ulcerating lesions of the pyloric ring are relatively rare, and the literature contains only a few widely

scattered studies of their significance. The author analyzes 20 examples compiled from a review of all cases of peptic ulcer and carcinoma of the gastric antrum reported by a medical group over a twenty-year period. Frank carcinomas of the pyloric antrum which had extended into the pyloric ring were excluded from the series.

There were ulcerating lesions of the stomach or duodenum in 2.8 per cent of all the cases studied. One in every 200 such ulcerating lesions (0.5 per cent) proved to be in the pyloric ring. The ulceration in the ring was demonstrated by direct visualization at operation in 15 cases and by roentgen examination alone in 5. The pathologic character of each lesion was proved by an adequate biopsy, a prolonged follow-up, or both. One of the 20 ulcers was malignant.

Fifteen patients were men, and 5 were women. Although their ages ranged from thirty-two to seventy-seven, 15 of the 20 patients were in the fifth or sixth decade.

The duration of symptoms at the time of diagnosis varied from three weeks to twenty years; the average was six and a half years. In only 11 cases was the clinical picture characteristic of "peptic ulcer." Gaseous distress after eating was the predominant symptom in 7 cases. Nausea was a complaint in 10. In 4, obstructive symptoms were present from time to time. Values for gastric acidity, when reported, tended to be lower than normal.

Accurate roentgen localization of the crater of the pyloric ring was made in 12 cases. In 5 others, craters localized roentgenologically as close to, but not in, the ring proved on operation to be in the ring. Antral spasm was observed fluoroscopically in 8 cases and spasm of the bulb in 7. In 2 cases, there was a significant four-hour retention of barium. The accurate roentgenographic localization of many lesions of the ring is possible with the aid of Smedal's triad: deformity of the base of the cap, a poorly differentiated sphincter, and antral spasm (see Radiology **39:** 200, 1942).

The results of surgical therapy in ulcer of the pyloric ring are considered good. However, 5 of the 15 patients operated on in the present series continued to have dyspepsia, though to a much lesser degree than before the operation. These cases do not represent failures of medical management. Ten of the patients were operated on under the impression that the ulcer was probably malignant, and 5 were operated on with the incorrect diagnosis of prepyloric ulcer. Only 3 of the 5 patients managed medically had results which could be considered good; these 3 patients have gone for many years without complications or noteworthy incapacity.

A review of the reported cases and the observations in the present series show that malignant ulcer within the ring is rare; benign ulcer is the rule.

One drawing; 1 table.

**A Case of Partial Atresia of the Pyloric Antrum Due to a Mucosal Diaphragm of Doubtful Origin.** C. Patrick Sames. Brit. J. Surg. **37:** 244–246, October 1949.

A case is reported of partial atresia of the pyloric antrum by a mucosal diaphragm, accompanied by a large gastric ulcer, for which the patient, a woman of 40 years, was seen primarily. The cause of this diaphragm-like structure across the pylorus was not ascertained, although the stomach was resected. Several possibilities are suggested; the clearly defined and regular nature of the diaphragm, unassociated with excess rugae, is believed to favor a congenital origin. The bizarre appearance is clearly demonstrated on the reproductions of the radiographs.

Three roentgenograms; 1 diagrammatic drawing.

S. F. THOMAS, M.D.
Palo Alto, Calif.

**Postgastrectomy Dumping Syndrome. Its Treatment by Section of the Vagus Nerve.** Norberto M. Stapler. Prensa méd. argent. **36:** 1761–1766, Sept. 9, 1949. (In Spanish)

The author believes that one should differentiate between an immediate and a late dumping syndrome following gastrectomy. From the standpoint of pathogenesis, the first condition is due to a state of parasympathetic hypertonia suddenly incited by the intake of food, which distends the efferent loop. It is only in these cases that vagotomy is indicated. On the other hand, when the symptoms appear late, that is, at least one hour after the ingestion of food, they are probably due to a disturbance of the mechanism regulating glycemia. Here dietetic treatment is preferable; vagotomy accomplishes nothing.

Four roentgenograms. JAMES T. CASE, M.D.
Chicago, Ill.

**Localized Sealed-Off Perforation in Recurrent Duodenal Ulcer.** Maurice Feldman. Am. J. M. Sc. **218:** 378–383, October 1949.

Acute perforation of a peptic ulcer usually produces a typical clinical picture that offers little diagnostic difficulty. In the type of sealed-off perforation reported in this paper, however, severe symptoms and shock were absent, there was no free air in the peritoneal cavity, and the patients were ambulatory. The author mentions three types of walled-off perforations: (1) a medical type, (2) a surgical type, and (3) chronic perforation with an accessory pocket. Only the first variety is discussed here.

Within a three-month period approximately 65 cases of duodenal ulcer in all stages were examined. Among these there were 5 cases of perforation of the walled-off medical type. These cases were selected for spot-film examination because of a clinical history of an abrupt onset of an unusually mild digestive episode. The case histories of the 5 patients are given.

The author points out that the only way of demonstrating the small gas bubble atop the duodenal bulb, which is characteristic of these cases, is in erect spot compression films. The air pocket above the duodenal bulb frequently contains a small amount of exudate or fluid. In none of the author's cases did barium enter the pocket nor was he able to demonstrate any communication between the duodenal bulb and the air pocket.

Six roentgenograms. HUGH A. O'NEILL, M.D.
Cleveland, Ohio

**Jejuno-gastric Intussusception.** D. M. Coates. Brit. J. Radiol. **22:** 544–546, September 1949.

A case of jejuno-gastric intussusception is presented and beautifully illustrated. It is pointed out that there are four possible types of such intussusception: herniation of the afferent loop, of the distal loop, of both

loops, and a slight prolapse of both loops. The typical picture is a mass showing concentric folds of jejunal mucosa.

Four roentgenograms. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

**Small Bowel Obstruction in Infancy and Childhood. A Radiologic Interpretation.** Charles Storch, Bernard Redner, and Richard D. Turin. J. Pediat. **35:** 366–372, September 1949.

Air in the small bowel of normal infants is seen on the roentgenograms as a hazy, formless conglomeration of radiolucencies. With obstruction, the gas pattern becomes abnormal, as evidenced by the appearance of distended, continuous loops of bowel, which in folding one upon the other form a sharp or "hairpin turn." When seen in cross section, the distended layers or loops of intestine have a square rather than a circular outline, due to the flattening effect of the adjacent loops pressing against one another. "Layering," or the appearance of parallel loops of distended small intestine, is a later sign of obstruction. Still later, fluid levels may be demonstrable. When the diagnosis of obstruction is uncertain, the demonstration of progressive distention on follow-up films will be conclusive.

The distended small bowel is distinguished from the colon by the following characteristics: 1. It is centrally located in the abdomen, while the colon usually follows the perimeter. 2. Transverse parallel stripes may be seen running completely across the lumen (Kerkring folds), while stripes in the colon (plicae semilunares) extend only partially across the lumen. The borders of the small bowel are smooth, whereas the colon shows haustral indentations.

Five cases of small bowel obstruction in infants are reported, with roentgenograms demonstrating the signs described above. The cause was volvulus in 2 cases, ileocecal intussusception in 1 case, incarcerated inguinal hernia in 1 case, and a "compression of the lumen of the distal one-third of the small intestine" in the last.

Seven illustrations, including 6 roentgenograms.
CORNELIUS COLANGELO, M.D.
Chicago, Ill.

**Acute Intestinal Obstruction Due to Lymphosarcoma of the Ileum in a Child Aged 5 Years.** Constance M. Ottley. Brit. J. Surg. **37:** 247–248, October 1949.

This article is a case history of a child seen at the age of five years with acute obstruction due to a lymphosarcoma of the ileum. Operation was done for an "acute appendix" and a growth of soft, friable vascular tissue was found obstructing the bowel lumen about 2 inches above the ileocecal valve. No enlarged nodes and no metastases were discovered. The involved loop of bowel was resected and an end-to-end anastomosis performed. The child remained well for eighteen months, at the end of which time symptoms of recurrence appeared. Exploration now revealed a mass in the retrocecal tissue, which responded only temporarily to irradiation. Death occurred about three years and four months after the original operation. Autopsy showed extensive involvement of the intestine but no metastases in the lymph nodes, peritoneum, or liver. The lungs, cardiovascular system, kidneys, and suprarenals were also normal.

Two photomicrographs. S. F. THOMAS, M.D.
Palo Alto, Calif.

**Functional Intestinal Obstruction in an Infant.** Michael A. Brescia and Edward F. Tartaglione. Arch. Pediat. **66:** 387–392, September 1949.

The case of a premature infant with temporary cardiospasm and some signs of intestinal obstruction is reported. There were vomiting, obstipation, and abdominal distention with visible peristaltic waves for the first five days of life. A gastro-intestinal study was made on the fourth day, following the introduction of barium into the stomach through a Levin tube. Barium was passed back into the esophagus by reverse peristalsis and there trapped. At two hours it was demonstrable as a triangular shadow with the apex pointing to an obstruction of the cardiac end of the esophagus. The presence of barium in the stomach and in the small intestine showed the obstruction to be incomplete. Without surgery the condition corrected itself and the infant went on to normal development. Expert care was necessary to maintain life during the first five days. It is postulated that the myenteric plexus was not functioning because of the prematurity.

Three roentgenograms; 1 chart.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

**Multiple Calcareous Deposits in the Intestinal Tract of the Newborn. Report of a Case Associated with Stenosis of the Ileum.** Raymond Camp and M. Hines Roberts. Am. J. Dis. Child. **78:** 393–400, September 1949.

A case of extensive calcification of the intestinal contents at birth is presented, without the usual accompanying perforation or concomitant peritonitis.

A film obtained one hour after spontaneous delivery showed innumerable calcium deposits, which were thought to be due to massive meconium peritonitis, throughout a greatly distended abdomen. The infant was operated upon because of signs of intestinal obstruction, but died forty-eight hours after birth.

Autopsy disclosed stenosis of the terminal ileum, which had produced the intestinal obstruction. The small intestine contained gelatinous and mucoid material and numerous firm round concretions, none of which were attached in any way to the mucous membrane of the bowel. Calcium concretions were also found in the bowel distal to the stenosis.

The cause of the deposition of the calcium is obscure. Calcium studies were not done on either mother or child, but autopsy showed that the bones of the infant were normal. The authors think that the calcification was due to local conditions in the gastro-intestinal tract, possibly a change in the pH of the bowel contents toward the alkaline side.

Five roentgenograms. GABRIEL WHITEMAN, M.D.
Louisville, Ky.

**Pregnancy Complicated by Regional Ileitis.** William C. Weir, Argyle J. Beams, and Frank S. Gibson. Ohio State M. J. **45:** 887–888, September 1949.

The authors report a case of regional ileitis complicating pregnancy. No similar case could be found in the literature. Pressure of the enlarging uterus apparently aggravated the inflammation in the ileum and caused it to become adherent to the pelvic wall over the ureter. The ureter became obstructed, necessitating cesarean section. Following delivery the patient was prepared for intravenous pyelography by

castor oil, which caused the enteritis to flare up. X-ray examination of the small intestine led to the diagnosis, which was confirmed at laparotomy. A short-circuiting operation and later resection resulted in steady improvement.

Two roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

**Fetal Meconium Peritonitis; Abscess; Intestinal Obstruction; Disappearance of Radiopaque Meconium Bodies.** C. W. Brunkow, Gunnar Nelson, Scott Goodnight, Arthur Hunter, and Milton Brunkow. West. J. Surg. **57:** 424–428, September 1949.

Fetal meconium peritonitis may be defined as a sterile foreign body and chemical irritation of the peritoneum caused by intra-uterine intestinal perforation with extrusion of meconium into the free peritoneal cavity. The meconium is sterile and fetal meconium peritonitis is non-bacterial until delivery, when it may soon become infected.

The cause of fetal meconium peritonitis is not known. It is often associated with intestinal obstruction secondary to atresia or meconium ileus. Perforation of the bowel probably occurs in the second half of pregnancy. Adhesions are produced and deposition of calcium occurs within the epithelial cells of the meconium.

The authors present a case diagnosed preoperatively. The patient, operated upon at four days of age for localized abdominal abscess and again at two months for acute intestinal obstruction, is living after twenty months and the abdominal calcifications which were observed in the preoperative roentgenogram are no longer visible.

Six roentgenograms; 2 photographs.
C. R. PERRYMAN, M.D.
Baton Rouge, La.

**Technic of Operative Cholangiography.** N. Frederick Hicken, V. L. Stevenson, Bruce J. Franz, and Earl Crowder. Am. J. Surg. **78:** 347–355, September 1949.

Cholangiography has been utilized by the authors in over 1,700 cases at operations on the extrahepatic biliary system. For injection of the gallbladder or dilated bile ducts, 35 per cent diodrast is used; for ducts of normal size, 70 per cent. A 10 × 12-inch cassette in a wooden film tunnel is placed beneath the patient, and exposures are made with a standard portable x-ray unit during the stage of apnea following pulmonary hyperventilation, to minimize motion.

A scout cholangiogram is first obtained. This outlines the entire biliary tract and is especially useful in cases of obstructive jaundice. A 20-gauge needle is then introduced into the gallbladder and 40 to 50 c.c. of diodrast is injected following aspiration of the gallbladder contents. If cystic duct obstruction is found, choledochography is performed by injecting 15 c.c. of 70 per cent diodrast directly into the common duct lumen. The latter procedure is also used in cases where there has been a previous cholecystectomy. Occasionally the contrast medium is injected directly into the stump of the severed cystic duct.

Retrograde choledochograms are used in cases where it is difficult to find the common duct. The papilla of Vater is cannulated after opening the duodenum and contrast medium is injected in a retrograde fashion.

Completion cholangiograms, to determine the status of the common duct after operation, are obtained before the removal of the drainage tubes, by injecting contrast medium through the T-tube placed in the duct, or *via* a cholecystostomy tube.

The authors emphasize the importance of cholangiography during the surgical exploration of the extrahepatic biliary system. The detailed anatomic information provided permits the surgeon to select the operative procedure best suited to alleviate the existing pathologic abnormality. The operations have not been prolonged by this measure.

Thirteen illustrations, including 6 roentgenograms.
D. B. NAGLE, M.D.
University of Pennsylvania

**Analysis of Postoperative Cholangiograms.** Julian A. Sterling, Paul S. Friedman, Vincent P. Ravel, and Leon Solis-Cohen. Surg., Gynec. & Obst. **89:** 292–298, September 1949.

The authors reviewed 50 postoperative cholangiograms obtained on 41 patients. They describe the normal cholangiogram, pointing out that the common bile duct averages 6.9 mm. in diameter; that it is divided into an extraduodenal and a transduodenal portion; that the most distal portion of the former is "transpancreatic" and that the latter terminates as a thin filamentous canal, the terminal orifice of which measures 1.5 mm. in diameter and lies at the approximate level of L-2. The origin of the common duct is given as at the level of T-12.

Abnormalities were observed in 25 cases, including choledocholithiasis, spasm, reflux into the pancreatic duct, and stricture of the common duct. Calculi are impacted usually at the distal portion of the extraduodenal segment, the narrow lumen of the transduodenal segment acting as a barrier to their passage into the duodenum. In one case a stricture of the termination of the common duct appeared six months after duct exploration, due, the authors believe, to trauma from forcible probing. They recommend that a small soft ureteral catheter, 3–5 mm. in diameter, be used as a probe.

Six roentgenograms. SAM H. SEAL, M.D.
University of Pennsylvania

## DIAPHRAGMATIC HERNIA

**Diaphragmatic Hernia from a Roentgenologic Viewpoint.** B. R. Kirklin. Texas State J. Med. **45:** 642–648, September 1949.

This is a general discussion of diaphragmatic hernia, with emphasis upon the diagnosis. Many hernias, particularly the small and reducible ones, are symptomless, and are accidentally discovered during roentgen examination of the chest. When symptoms do occur, pain is the most common manifestation. Other symptoms may be referable to the gastro-intestinal tract, such as dysphagia, bloating, nausea and vomiting, or to the cardiovascular and respiratory systems, such as dyspnea. Diagnosis is essentially by roentgenologic means, barium being used to outline the gastro-intestinal tract. If the hernia has been reduced spontaneously, the intra-abdominal pressure should be increased by applying manual pressure to the abdomen, especially in the recumbent position. The relative positions of the viscus and the thin curvilinear shadow of the diaphragm are then compared.

Harrington's classification of diaphragmatic hernia is

probably the most satisfactory. It includes four varieties of hernias through the esophageal hiatus: congenitally short esophagus, esophageal hiatus hernia with acquired shortening and without shortening, and para-esophageal hernia. There are also hernias through the foramen of Morgagni, through the foramen of Bochdalek, and through congenital and traumatic defects of the diaphragm.

The author points out that routine roentgenograms of the thorax in infants suffering from cardiac or respiratory embarrassment, will reveal many congenital hernias. Fully three-fourths of the infants with herniation through the foramen of Bochdalek die in the first month of life if not treated.

Seventeen roentgenograms.

GABRIEL WHITEMAN, M.D.
Louisville, Ky.

**Ulcer Associated with Diaphragmatic Hernia.** Glenn F. Miller and Howard P. Doub. Am. J. Roentgenol. **62:** 368–374, September 1949.

On the basis of 22 cases of gastric ulcer associated with hiatal hernia collected from the literature and 6 of the authors' cases it is concluded that the occurrence of ulceration in conjunction with diaphragmatic hernia is more frequent than has been realized. It is probable that a number of these cases are being missed roentgenographically and it is recommended that a careful roentgenologic study be made for ulcer craters in such cases.

The ulcers occur primarily on the lesser curvature in the narrowed area of the stomach where it passes through the esophageal hiatus. They are considered to be primarily the result of irritation and trauma to the stomach wall by the constricting action of the hiatal orifice, which leads to congestion, varicosities, disturbance of the arterial blood supply, and eventually to erosion and active ulcer. Other factors are the strain produced in the act of vomiting and the presence of active secreting glands, which are more abundant on the lesser curvature side of the stomach.

Symptomatology of ulcer associated with hiatal hernia is dependent upon the extent of the herniation, the degree of constriction produced, and the amount of embarrassment to the thoracic contents. Few cases present typical ulcer symptoms, but one finding which has impressed the authors strongly is that clinical indication of gastro-intestinal hemorrhage is almost invariably present.

Thirty-eight cases of esophageal ulcer in patients with congenital short esophagus and thoracic stomach were discovered in the literature and reviewed. The etiological factor in these cases was believed to be regurgitation of the acid gastric juice and its eroding action on the stratified squamous epithelium of the esophagus.

Nine roentgenograms. F. R. MCCREA, M.D.
Indiana University

## THE SPLEEN

**Calcified Splenic Cyst. Report of a Case.** Mischa J. Lustok and George L. Baum. Dis. of Chest **16:** 329–335, September 1949.

The authors give the case history of a 51-year-old white male in whom they accidentally found a calcified splenic cyst. Investigation yielded no etiological clue. Roentgen examination revealed a large ring-like radiopaque shadow posteriorly and laterally below the left diaphragm. It was extragastric, extracolonic, and extrarenal. Diagnostic pneumoperitoneum located the cyst in the spleen.

Eight roentgenograms. HENRY K. TAYLOR, M.D.
New York, N. Y.

## THE MUSCULOSKELETAL SYSTEM

**Relationship of Hand-Schüller-Christian's Disease, Letterer-Siwe's Disease and Eosinophilic Granulomas of Bone (With Report of Five Cases).** Poul Bjerre Hansen. Acta radiol. **32:** 89–112, Sept. 30, 1949.

The author develops the present pathological and clinical concepts of the three diseases mentioned in the title by describing the historical steps through which the current theories have evolved. A brief discussion is devoted to the clinical picture of each of these three reticuloses.

Hand-Schüller-Christian's disease is characterized by defects in the cranial bones, exophthalmos, and diabetes insipidus; however, this is not a constant triad. The clinical picture is dependent upon the extent and locale of the xanthomatous processes. Letterer-Siwe's disease is manifested by splenomegaly, hepatomegaly, palpable lymph nodes, secondary anemia, a tendency toward hemorrhagic diathesis, and dermatitis, and is found exclusively in children two to three years of age. It always carries a poor prognosis. Eosinophilic granuloma is represented by localized osteolytic bone lesions and occurs in late childhood and adult life. There is swelling over the point of bone involvement, which is subjectively tender. The course is benign.

The works of several authorities who believe the three conditions in question are correlatives, being variable manifestations of the same entity, are discussed. The views of authors with opposed theories are also listed.

Five case reports are presented, each showing varied, as well as common, clinical and pathological findings. These cases seem to represent transitional and mixed forms of Hand-Schüller-Christian's disease, Letterer-Siwe's disease, and eosinophilic granuloma; some had findings of all three. The clinical and laboratory observations in the five patients are summarized in chart form and also discussed. The histopathological examinations demonstrated transitions and a certain continuous development corresponding to the four phases in the pathogenesis previously demonstrated by Danish authors. These phases are: (1) hyperplastic, proliferative reticulohistiocytic phase, (2) granulomatous phase with eosinophilic cells, macrophages, and giant cells, (3) xanthomatous phase, dominated by lipoid storage (as evidenced by "foam cells"), and (4) the fibrous healing phase. It is felt that Letterer-Siwe's disease represents the first phase, eosinophilic granuloma and Hand-Schüller-Christian disease, the second and third phases. The fourth phase of fibrous healing comprises the chronic cases, and the eosinophilic granulomas with a benign course may readily be classified in this phase.

The factors that determine the phasal development of the disease are unknown, but age plays an important role. Thus the acute and malignant forms occur in infants (as Letterer-Siwe's disease), and the chronic, more benign course in young persons and adults (especially eosinophilic granuloma, and, at times, Hand-Schüller-Christian's disease).

In summary, the author states that Letterer-Siwe's disease, Hand-Schüller-Christian's disease, and eosinophilic granuloma are different phases of the same disease, caused by a disorder in the reticulo-endothelial system.

Nine roentgenograms; 7 pathological studies; 1 table. J. W. WILSON, M.D.
Indiana University

**Significance of Cartilage in Abnormal Locations.** Bradley L. Coley and Norman L. Higinbotham. Cancer **2:** 777–788, September 1949.

The authors call attention to the menace afforded by the insidious tendency of benign tumors derived from cartilage to become malignant. From a study of 21 cases found in the records of the Bone Tumor Department of Memorial Hospital (New York), they believe that the majority of chondrosarcomas in individuals more than twenty-five to thirty years of age are derived from pre-existing benign cartilaginous lesions. While these changes take place, as a rule, in single lesions, the authors have observed the development of sarcoma in 3 cases of multiple cartilaginous exostoses.

In the interpretation of roentgenograms of a case suspected of being a central chondroma, one may be guided by the location of the tumor. If the lesion lies in the diaphysis of a long bone or in the epiphyseal region, extending into the diaphysis without producing much expansion, it is unlikely that it is a giant-cell tumor. If, at some point in the periphery of the osteolytic area, the cortex has been eroded and a palpable, bulky soft-part swelling is seen, one can be almost certain that chondrosarcoma is present. In the roentgenogram of a peripheral chondroma the following features suggest malignant evolution: An irregular area of erosion or destruction or, conversely, an additional area of productive calcific tumor tissue is strong evidence of sarcomatous transformation. While mere size is not of itself an index of benign or malignant properties, one should look with suspicion on large bulky tumors with many irregular calcific areas.

Peripheral chondromas (osteochondromas) should be extirpated surgically, and complete removal is essential. The removal should be wide enough to pass through normal bone without leaving behind any cartilaginous tissue. When lesions are multiple (hereditary dyschondroplasia), it may not be practical to remove all of them, but continued observation is desirable. Central chondromas likewise should be removed, and this is best achieved by wide resection through uninvolved bone. If this can be accomplished by segmental resection, such a procedure is the method of choice. However, in a major long bone, especially of the lower extremity, meticulous curettage, chemical cauterization followed by implantation of bone fragments, and primary wound closure are sometimes successful.

Roentgen therapy does not appear to be indicated, and it is not employed either for operable benign chondroma or secondary chondrosarcoma. An exception might be made in cases that are already malignant and in which no form of radical surgery is feasible. However, at best, such treatment is obviously only palliative.

The conclusion is drawn that a much more aggressive attitude toward benign cartilaginous neoplasms is highly desirable and would result in saving of many lives that are now being lost. The authors' 21 cases are tabulated and 8 case histories are included, illustrated by 4 roentgenograms, 3 photomicrographs, and 4 photographs. DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

**Dyschondroplasia. Report of a Case.** Erling Kierulf. Acta radiol. **32:** 169–172, Sept. 30, 1949.

A case of multiple enchondromata and cartilaginous exostoses confined to the left side of the body is reported. The patient was a twenty-one-year-old male who first noticed a swelling of his left little finger at the age of seven. Swelling and deformities subsequently developed elsewhere, and on examination roentgenograms revealed enchondromata of the left toes, wrist, fingers, and a rib, as well as cartilaginous exostoses of the humerus and fibula.

The author briefly reviews the literature and concludes that Ollier's disease, enchondromatosis, and multiple cartilaginous exostoses are different manifestations of a dyschondroplasia.

Six roentgenograms. P. B. LOCKHART, M.D.
Indiana University

**Monostotic Fibrous Dysplasia. Report of Two Cases.** S. L. Cooke and W. H. Powers. Arch. Otolaryng. **50:** 319–329, September 1949.

That fibrous dysplasia is not a rare lesion is attested to by the variety of terms which have been used to describe the condition. However, only 9 cases in which the maxilla and 3 cases in which the frontal bone was involved have been recorded under the title fibrous dysplasia. One case is added to each of these groups.

Three roentgenograms; 2 photomicrographs.

**Osteogenic Sarcoma with Multiple Skeletal and Visceral Involvement.** Béla Halpert, Peter E. Russo, and Victor C. Hackney. Cancer **2:** 789–792, September 1949.

The clinical history and findings at necropsy of a 7-year-old white girl with osteogenic sarcoma, apparently of multicentric origin in the skeleton, with extensive visceral metastases, are presented and discussed. Roentgenograms disclosed proliferating and sclerosing lesions of dorsal and lumbar vertebrae, bony pelvis, both femurs, tibias, and tarsal bones, both humeri, the right ulna and radius, and two metacarpal bones, and patchy irregular areas of infiltration in both lung fields.

Three roentgenograms; 3 photomicrographs.
DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

**Roentgen Findings in Injuries of the Wrist.** John T. Farrell, Jr., Burton L. Williams, and Mario A. Cinquino. Pennsylvania M. J. **52:** 1359–1361, September 1949.

A complete study of the bones of the wrist should include a dorsopalmar, a lateral, and an oblique view, and a special study of the navicular in the dorsopalmar projection with the fist clenched and the hand turned to strong ulnar deviation. Comparison films should be taken of the opposite side. If there is clinical evidence of a fracture and none is shown on the films, a repeat examination should be made in two or three weeks. Hair-line fractures may be missed if the films are not studied with a magnifying glass.

Injuries of the carpal bones comprise about one-

tenth of all wrist injuries, including Colles fracture. The navicular is the most frequently fractured carpal. Dislocation of the lunate, fracture of the lunate, and fracture of the triangular follow in order of frequency.

Fractures of the navicular comprise about 80 per cent of the fractures of the carpal bones. They may be complete, incomplete, intra-articular, extra-articular, recent, or old. If normal healing occurs, callus will be present in four weeks; at eight to ten weeks enough osteoid tissue should be present to represent clinical union; and three to six months are required for firm bony union and obliteration of the fracture line.

Dislocation of the lunate is of more frequent occurrence than fracture because the bone is less well anchored than the other carpal bones. A lateral view will show it to be palmar to the capitate, with its deep concavity plainly visible.

Ten roentgenograms. JOSEPH T. DANZER, M.D.
Oil City, Penna.

**Roentgenologic Examination of the Cervical Spine.** Joseph C. Bell and James B. Douglas. Am. J. Roentgenol. **62:** 380–386, September 1949.

The technic of an adequate standard method of examination of the cervical spine, such as is used by the authors, is briefly presented. Erect lateral and direct anteroposterior projections, an open-mouth view, and prone right and left postero-anterior oblique projections are employed. These examinations should always precede cervical myelography in order to rule out hypertrophic changes about the lateral foramen that may simulate rupture of the intervertebral disk.

Cervical myelography is always done with the neurosurgeon injecting and maintaining the position of the patient. The quantity of pantopaque used is 6 c.c. Serial exposures, with the column of contrast material at various levels, are made through a narrow rectangular opening in the roentgenoscopic shutter. A number of exposures are made because small lesions obliterating only the root sleeves may be missed fluoroscopically.

The authors believe that cervical myelography yields information not obtainable by other means, amply justifying its employment.

Thirteen roentgenograms.
DAVID C. GASTINEAU, M.D.
Indiana University

**Failure to Disclose Ruptured Intervertebral Disks in 32 Operations for Sciatica.** Dean H. Echols and Frederick C. Rehfeldt. J. Neurosurg. **6:** 376–382, September 1949.

In 32 patients operated upon for ruptured intervertebral disks equivocal herniations or non-disk lesions were found or exploration was negative. In 18 of these cases an adequate explanation for sciatica was demonstrated. These consisted of 8 cases of bulging disk, 4 cases in which the nerve root was adherent to the disk, 4 cases of root compression by hypertrophy of bone, 1 case of spondylolisthesis, and 1 case of congenital malformation of the dural sac. In the other 14 cases no pathological condition could be demonstrated. The authors were able to postulate a possible explanation for the sciatica in only 7 of this group.

It is concluded that an orthopedic consultation for all patients and myelography in cases in which the diagnosis is doubtful are indicated.

Three tables. HOWARD L. STEINBACH, M.D.
University of California

**De-Ossification in a Lumbar Transverse Process.** R. A. Roberts. Brit. J. Radiol. **22:** 540–543, September 1949.

A case is described in a male, age 24, complaining of back pain, who showed demineralization of the inferior articular process of the third lumbar vertebra with a translucent line similar to those seen in stress fractures. Recalcification occurred after immobilization. The possible etiology is briefly discussed, and overstrain is postulated as the responsible factor.

Ten roentgenograms. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

**Extraocular Muscle Paralysis from Spinal Injection of Pantopaque.** Edwin S. Wright. California Med. **71:** 214–215, September 1949.

This is a brief case report describing paralysis of the external rectus muscle of the right eye, occurring five days following myelography with pantopaque. The symptoms were remarkably similar to previously reported cases of abducens paralysis following spinal anesthesia. Spontaneous recovery occurred with conservative treatment. EDWARD E. LEVINE, M.D.
Dearborn, Mich.

**Late Manifestations of Osgood-Schlatter's Disease.** J. E. W. Brocher. Schweiz. med. Wchnschr. **79:** 890–891, Sept. 24, 1949. (In French)

The author notes that the late manifestations of Osgood-Schlatter's disease are given little attention in the literature, although similar manifestations of other epiphyseal dysplasias such as Calvé-Legg-Perthes' and Scheuermann's diseases are well recognized. The late manifestations of Osgood-Schlatter's disease are circumscribed pain over the tibial tubercle, at times accompanied by heat or rarely redness; a palpable tumor; remote pain, either in the region of the patella or at the apex of the articular line, generally in the midline. In 6 of 7 cases there was shortening of the patellar tendon or retardation of its growth, which tends to favor the development of arthritic changes. A lateral x-ray film shows the typical change, an abnormally prominent tubercle separated from the tibial shaft. Therapy is in general the same as for an arthritis of the knee. Small doses of radiotherapy are recommended, among other measures. The best prophylaxis is adequate treatment in adolescence.

Three roentgenograms. LEWIS G. JACOBS, M.D.
Oakland, Calif.

**Arachnodactyly. Review of Recent Literature and Report of a Case with Cleft Palate.** Lucille J. Ross. Am. J. Dis. Child. **78:** 417–436, September 1949.

The author reports a case of arachnodactyly in an infant of six weeks and presents in tabular form details of 87 cases which have appeared since Rados' summary of the literature published in 1942 (Arch. Ophth. **27:** 477, 1942). The author's patient had a cleft palate.

One photograph; 2 tables.

**A Radiological Investigation of Weight-Bearing Changes in the Human Foot.** G. McL. Turnbull. M. J. Australia **2:** 455–456; Sept. 24, 1949.

The author undertook to demonstrate changes in the relationship of the bones of the feet produced by weight-bearing. Vertical and lateral roentgenograms were made of the feet of 100 students between the ages

of seventeen and thirty-six years, in standing and sitting positions. It was noted that under body weight the medial longitudinal arch is depressed on an average of 2 mm. and lengthened by 4 mm. The right foot shows slightly greater change than the left. No difference was noted between the sexes.

Two drawings: 5 tables. ALTON S. HANSEN, M.D.
Peoria, Ill.

## GYNECOLOGY AND OBSTETRICS

**A Basic Analysis of the Obstetric Pelvis by Roentgen Study.** William Snow. Am. J. Obst. & Gynec. **58:** 752–757, October 1949.

Snow, reviewing his roentgen observations in some 10,000 pregnancies, found difficulty in describing all female pelves according to the classification of Caldwell and Moloy, because of overlapping of types and variations in the extent of any given one. Accordingly, he uses only the two broad classifications, gynecoid and android. Variants from the two pure types are classified simply by describing the way in which they vary. Analysis of one thousand consecutive roentgen pelvimetric studies in females demonstrated 30 per cent typical gynecoid pelves, 12 per cent typical android pelves, and 58 per cent mixed types. The mixed types are described with reference to the following factors: pelvic inlet (anterior and posterior segments), sacrum, ischial spines, convergence of lateral walls, subpubic arch, bulge of acetabulum, pubic lips, and sacrosciatic notches.

Snow feels that the important basic influences on the shape of the pelvis are: (1) hormonal, resulting in gynecoid, android, and mixed types; (2) developmental, influencing degree of sacralization of the sacrum; (3) nutritional, especially rickets or vitamin B deficiency; (4) injury or infection.

Twelve drawings; 3 tables. T. F. WEILAND, M.D.
Jefferson Medical College

**Transverse or Oblique Presentation of the Fetus in the Last Ten Weeks of Pregnancy: Its Causes, General Nature, and Treatment.** Charles S. Stevenson. Am. J. Obst. & Gynec. **58:** 432–446, September 1949.

The author discusses the principal causes and significance of transverse or oblique presentation of the fetus in the last ten weeks of pregnancy. He has shown, in a review of 52 cases, that when the placenta is implanted in the fundus or the lower uterine segment, it causes a considerable change in the shape of the amniotic sac cavity. Implantation of the placenta at the above sites and a relatively high degree of multiparity are the two principal causative agents of transverse presentation of the fetus. Additional etiologic factors are cephalopelvic disproportion, hydramnios, fetal death *in utero*, relaxation of the abdominal wall, and ventral hernias.

Soft-tissue placentography and cystograms are indicated in all women with transverse presentation in the last ten weeks of pregnancy: (1) to establish the presence or absence of placenta previa; (2) to determine if the placenta is implanted in the general fundal region; (3) to rule out uterine or extrauterine tumors, hydramnios, fetal death *in utero*, gross fetal anomalies or abnormalities of the uterus.

External cephalic version is an important preventive therapeutic measure in women with transverse presentation of the fetus in the last six weeks of pregnancy. Pursuing this policy, the author was able to accomplish delivery through the pelvic canal in 63 per cent of his patients.

It is conclusively demonstrated that the position of the placenta, *in situ*, in the near-term uterus has a definite influence upon the presentation of the fetus.

Four figures, including 2 roentgenograms; 3 tables.
ROBERT LEAMING, M.D.
Jefferson Medical College

**Attitude of the Fetus in Breech Presentation.** Howard L. Wilcox. Am. J. Obst. & Gynec. **58:** 478–487, September 1949.

In a study of 45,875 full-term and premature deliveries reviewed by the author, the incidence of breech presentation was 4.2 per cent. The fetal mortality rate in breech deliveries is much too high; in this series it was 12 to 14.8 per cent for multiparas and 9.8 per cent for primiparas.

In x-ray examinations of 216 cases of breech presentation the military or neutral attitude of the vertex was most commonly encountered. This is in agreement with Brakemann's observations (Ztschr. f. Geburtsh. u. Gynäk. **112:** 154, 1936), but his impression that operative interference is necessary most commonly in the cases showing an extended attitude of the fetus is challenged.

The author does not believe cesarean section is indicated because of a hyperextended vertex *per se*, and the theory that extreme hyperextension of the vertex may be responsible for longer labor is not substantiated in this series.

The attitude of the fetus as shown by radiological studies is important in evaluating the most satisfactory course of treatment in breech presentation.

Three roentgenograms; 7 tables.
ROBERT LEAMING, M.D.
Jefferson Medical College

**An Essay on the Physiology of the Third Stage of Labour.** Jean R. C. Burton-Brown. J. Obst. & Gynaec. Brit. Emp. **56:** 847–855, October 1949.

A method of investigating the separation and expulsion of the placenta by roentgenography following injection of an opaque substance into the umbilical cord after birth is described. Thirteen cases studied by this procedure are reported. In 1 case there was an accidental opacification of a maternal vessel.

The placentas were found to separate either by the Schultze or Duncan mechanism. In the *Schultze mechanism* the placenta separates and is expelled from the uterus by becoming inverted at its center. The fetal surface is most dependent and appears this way at the introitus, dragging the membranes after it. In the *Duncan mechanism*, the placenta shears vertically down the uterine wall, and presents at the introitus by its lower edge, the membranes appearing at the same time.

The situation of the placenta in the upper segment appears to have no relation to its speed of separation. However, it may well affect the way in which the placenta is driven into the lower segment. If the placenta is situated even partially on the fundal wall, the Schultze mechanism is likely to occur. Other factors such as a large placenta and high or symmetrical insertion of the cord appear to favor the Schultze mechanism.

The membranes definitely influence the mechanism of expulsion. If the membranes separate almost simultaneously with the placenta, the Schultze mechanism is likely to occur. If contractions are poor, the membranes take longer to separate, the upper end of the placenta will then be held in the upper segment, and the Duncan mechanism occurs. Forceful expression of the placenta before it is completely in the lower segment will change a Schultze mechanism into that of Duncan.

In the cases studied there was a much greater blood loss with the Duncan mechanism.

Ten illustrations, including 8 roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

**Pattern of Uterine Growth During Pregnancy in Monkeys as Shown in an X-ray Study.** Edward Clark Gillespie, Elizabeth Mapelsden Ramsey, and Samuel R. M. Reynolds. Am. J. Obst. & Gynec. **58:** 758–764, October 1949.

The authors undertook a study of the pattern of uterine growth in 6 pregnant monkeys (*Macaca mulatta*). In 2, abortion occurred before they could contribute any significant data to the study. A third monkey was sacrificed on the ninetieth gestational day, leaving 3 to be studied until term. Uterine growth was observed by serial lateral soft-tissue roentgenograms of the abdomen. The authors believe that a change in the shape of the uterus occurs between the 100th and 105th days of gestation. At this time the uterus elongates, changing from a predominantly spheroid to a predominantly cylindrical organ.

These studies produced findings similar to those of Reynolds on litter-bearing animals (rabbits). In the previous studies the uterus was found to grow until a period called by the authors "conversion" was reached. At that time the uterus rapidly elongated and subsequent uterine enlargement was accomplished chiefly by stretching of the myometrial components already present, rather than by growth of new elements.

The authors feel that the mechanism described above implies that the onset of labor is governed, in part, by the degree of uterine growth which occurs prior to "conversion" and that fetal maturity at birth is related to the length of the post-conversional phase.

Four roentgenograms; 4 charts and diagrams.

T. F. WEILAND, M.D.
Jefferson Medical College

## GENITO-URINARY SYSTEM

**Perirenal Insufflation.** Alejandro Juri. Prensa méd. argent. **36:** 1733–1736, Sept. 2, 1949. (In Spanish)

From the service of the Professor of Clinical Surgery, José M. Urrutia, of the National University of Córdoba, comes a suggestion of a new approach in perirenal insufflation. The patient is placed in the genupectoral position, leaning his hands on a small stool placed in front of him near the radiographic table. The physician stands behind the patient. Under due sterile precautions, with the guidance of the thumb of the right hand, the lower sacral and first coccygeal vertebrae are identified, and the coccygeal hiatus located. More or less a finger's breadth either to the right or left of this line, a puncture is made with a needle such as is employed for spinal puncture, 1 per cent novocaine having been injected into the skin at the site selected. One attempts to direct the spinal puncture needle toward the median line and inward until its point reaches the fibrocellular-fat presacral tissues. To determine if the needle is properly placed, aspiration is made to be sure that blood is not withdrawn. Oxygen is used for the contrast material, taken directly from a rubber balloon. An assistant makes pressure on the balloon and one notes if oxygen enters. If oxygen does not pass easily, the position of the needle is changed. The gas is introduced into the pelvic cellular tissues. Three hundred cubic centimeters, more or less, should be injected. By this time the patient should complain of heaviness in both lumbar regions.

The advantages of the method are that it is not necessary to make two punctures, since with this technic both kidneys are equally well surrounded by the injected gas; the patient suffers no pain; the danger of gas embolism is avoided, because the tissues through which the needle passes are very slightly vascularized; the oxygen is diffused without producing trauma, except for occasional rupture of very small vessels by traction; the procedure can be completed, including exposure of films, within fifteen minutes.

JAMES T. CASE, M.D.
Chicago, Ill.

**Focal Exclusions in Renal Tuberculosis.** Roland Gay. Acta radiol. **32:** 129–144, Sept. 30, 1949.

Tuberculosis of the kidney may run either of two courses: (1) terminating in caseation, which is the most common development, (2) terminating in cicatrization. The so-called "exclusions" are representative of the latter type. In these cases the focus is sealed off from its surroundings and is no longer able to pour its purulent and infectious discharge into the urine. Both total and partial exclusions are recognized. Total exclusion is caused by obliteration along a varying length of the ureter. In partial exclusion the tuberculous foci are sealed off by an obliteration of the calyx or of a group of calyces draining the lesion.

The consequences of these exclusions vary. In some cases the process is quiescent or inactive for long periods. Occasionally a complete healing of the tuberculous process is seen. In other cases latency is but transient, with the formation of new foci and spread of the process by ulceration elsewhere into the renal pelvis. In such cases the sealed or closed process constitutes a latent threat.

The authors report six cases, describing the roentgen findings in each and concluding that good excretory urography will give a picture distinct enough to judge the condition. They believe that retrograde pyelography should be applied only exceptionally as a complementary measure to urography, because of the risk of forcing tubercle bacilli into healthy kidney, causing a lesion with a miliary spread of the disease, and injuring an exclusion in the process of formation so that it will no longer be capable of completion.

The authors tend toward conservative treatment in renal tuberculosis, with the use of periodic urographic examination to determine whether the lesions show any signs of healing or aggravation. One sign of healing is the occurrence of focal exclusions.

Nineteen roentgenograms; 1 photograph; 1 diagrammatic drawing.

F. R. MCCREA, M.D.
Indiana University

**Renal Colic in Cases of Tumor and Tuberculosis of the Kidney. Roentgenologic Views.** Olle Olsson. J. Urol. **62:** 118–127, August 1949.

Though renal colic is most often attributable to calculi, the author here considers it as a symptom of tumor or tuberculosis. Acute pain, common in these conditions, is generally thought to be due to hemorrhage, which may produce obstruction of the urinary tract by clots.

In a series of 87 cases of renal tumor in adults, colic occurred in 17. There was associated hematuria in 14 patients, and in several this was definitely said to be of the "coagulum type." Macroscopic hematuria was present in 3 of 4 cases in which urography was done during an attack.

Among 114 patients with tuberculosis of the kidney, 30 had pains simulating renal colic. Macroscopic hematuria was observed in only 6 of this group, however, and was present in none of those examined during an attack. Other causes for the pain must therefore be sought in the majority of the cases. In some it may be explained by pyelitis, but in others there are not sufficient criteria for pyelitis of such a degree as to produce pain. It is suggested that involvement of the ureter or bladder, which is common in tuberculosis, may give rise to obstruction and that dilatation of the renal pelvis, already present in many cases, may contribute to eliciting renal colic even where obstruction is slight.

Two points to which the author calls attention are (1) the occasional occurrence of colic on the uninvolved side, from which it is concluded that the site of the pain cannot be taken as indicative of the side of involvement in renal tuberculosis, and (2) the possible occurrence of calculi in association with either tuberculosis or tumor.

Hellmer (Acta radiol. **16:** 51, 1935) summed up the roentgen symptomatology in renal colic in the following six points: (1) delay or failure of contrast filling of the renal pelvis on the affected side; (2) considerably increased density of the renal shadow on the side where stasis is found; (3) an increase in the size of the renal shadow; (4) contiguous contrast filling of the ureter; (5) dilatation of the renal pelvis and the ureter; (6) delayed evacuation of contrast medium from the renal pelvis and the ureter.

The misinterpretation of the urographic findings in tumor or tuberculosis of the kidney falls into two groups. (1) In the first group the attack is a clear case of renal colic and the possibility of misinterpretation refers to the factor which has elicited the attack. The attack manifests itself urographically as stasis. If the presence of a calculus is not definitely established, the attack should not be considered as due to this cause, though it is to be borne in mind that a calculus may be too small, or too poor in calcium, to be visible in the urogram, or it may have passed immediately prior to the examination. In such cases it should be sought in the bladder and in the urethra.

(2) The second group concerns the differential diagnosis of the attack itself. Failure of contrast filling may not be dependent upon the attack, but be due to destruction of parenchyma in the kidney by tumor or tuberculosis. Similarly delayed excretion was present in 20 of 114 cases of renal tuberculosis and in 9 of 80 cases of hypernephroma. Dilatation of the renal pelvis and ureter may occur both in tumors and in tuberculosis. Contrast filling of the ureter is a common finding in tuberculosis, owing to changes at the orifice of the ureter in the bladder. Conditions outside the urinary tract should also be kept in mind in seeking the cause for the colic.

If a suspicion of tumor or tuberculosis has arisen from the roentgen or from the clinical examination, urography should be performed again when the attack of colic has ceased. This holds for all cases where it has been impossible to find a calculus. For the second examination, the patient should be carefully prepared, and compression of the ureters should be applied.

**Early Diagnosis of Cancer of the Kidney.** D. K. Rose. S. Clin. North America **29:** 1483–1503, October 1949.

This paper emphasizes the necessity of a systematic method in making a diagnosis of, or excluding, cancer of the kidney. This should facilitate early diagnosis, the object being to establish the origin of urinary infection, hematuria, or pain. The successive steps in such a procedure are history, physical examination, examination of the urine, rectal examination, test for residual urine, and x-ray examination.

The advantages and limitations of intravenous urography are pointed out, and instances in which excretory and retrograde urography complement each other are dealt with. Some of the newer or less used diagnostic procedures, such as perirenal air insufflation and aortography, are briefly discussed; reference is made to cytological studies after the principles of Papanicolaou and Marshall.

Classification of malignant kidney tumors is simplified, and the cellular types are described. Treatment by surgical excision and high-voltage roentgen therapy is briefly discussed. The plea is for early diagnosis, and the method presented should be of great value in this respect.

Twenty-two illustrations, including 7 roentgenograms.

ALTON S. HANSEN, M.D.
Peoria, Ill.

**Roentgenographic Studies of Hydronephrosis Due to Obstruction at the Uretero-Pelvic Junction.** K. Lindblom. Acta radiol. **32:** 113–120, Sept. 30, 1949.

Hydronephrosis due to obstructions at the uretero-pelvic junction is best studied by means of intravenous pyelography. The author uses a method which he calls "prolonged urography." This consists of first filling the pelvis by repeated injections of the contrast medium, then using a compression apparatus over the ureter until it, too, is filled, and finally positioning the patient as necessary to study the uretero-pelvic junction. Films are made both before and after removal of the ureteral compression.

Obstructions may be due to (1) adhesions between the ureter and pelvic wall, (2) stricture or valve in the ureteral orifice, or (3) an aberrant renal vessel. In the presence of adhesions fixing it to the pelvic wall, the ureter may be seen to arise from the medial or anterior wall of the pelvis, along which it runs. The lower pole of the pelvis is often elongated and is seen to run caudally. In obstructions due to an aberrant renal vessel the ureter starts at the lower pole of the pelvis and runs medially, riding over the aberrant vessel, where it forms a knee before turning caudally. When the ureter empties, the portion proximal to the knee remains filled.

Nineteen roentgenograms.

J. G. LORMAN, M.D.
Indiana University

**Solitary Pelvic Kidney: A Case Report.** Owen C. Berg and Walter M. Kearns. J. Urol. **62:** 275–277, September 1949.

**Pelvic Single Kidney: Report of a Case.** William B. Wall and Earl C. Lowry. Urol. & Cutan. Rev. **53:** 518–520, September 1949.

Berg and Kearns report a case of solitary pelvic kidney in a man of thirty-nine and cite 3 other cases not listed in previous tabulations (see Mays: J. Urol. **56:** 619, 1946. Abst. in Radiology **49:** 525, 1947), bringing the total number in the literature to 45.

Wall and Lowry, in reporting a case in a young pregnant woman, mention 4 cases not covered by Berg and Kearns, so that the present total comes to 50.

Both papers are illustrated by pyelograms.

**Retrocaval Ureter. A Case Diagnosed Pre-Operatively and Treated Successfully by a Plastic Operation.** J. C. Anderson and Wilfred Hynes. Brit. J. Urol. **21:** 209–214, September 1949.

A case of retrocaval ureter which was diagnosed preoperatively and treated successfully by a plastic operation is reported. The patient was a 10-year-old girl, admitted to the hospital with a diagnosis of "chronic appendix." Because the pain was not umbilical in distribution, a urinary investigation was carried out and the true nature of the condition was revealed.

This case lends emphasis to the importance of intravenous pyelographic studies in children with recurrent abdominal pain. In a period of eighteen months the authors found 6 cases of hydronephrosis and other congenital abnormalities of the kidney, some left-sided, among cases referred as "chronic appendicitis." They regard the ten-minute emptying film after retrograde pyelography as one of the most important steps in establishing pathological degree of retention in the upper urinary passages.

The extraperitoneal approach to the kidney and ureter through an oblique incision, with the patient supine, is advocated. Splinting of any anastomosis is considered not only unnecessary but against all the principles of plastic procedure, as it leads to infection and fibrosis at the line of suture and subsequent stricture. The line of anastomosis should be wide enough and so fashioned as to render any subsequent contraction innocuous. Nephrostomy was not done in the case reported.

Four pyelograms; 5 drawings.

**Fatal Embolism Following Urethrography.** Howard Gaudin. J. Urol. **62:** 375–377, September 1949.

A case of fatal embolism following urethrography in a 61-year-old man is reported. The method employed had been routine for five years, with uniformly good results in some hundreds of cases (New Zealand M. J. **45:** 376, 1946. Abst. in Radiology **49:** 125, 1947). The contrast medium was a 40 per cent suspension of barium in a 0.5 per cent gum acacia solution in water. The medium flowed easily, the pressure recorded being below that usually noted (100 mm. Hg). An exposure was made while the medium was flowing. The patient appeared quite comfortable, and about ten minutes later stood down from the table. He then complained of dizziness, and the attendant thought he was going to faint. The heart stopped about ten minutes after the original injection. In the film taken at the time the injection was made, the contrast medium could be seen throughout the cavernous bodies, the corpus spongiosum at least, and through the veins of the pelvis. Postmortem roentgenograms showed the medium ascending in the iliac veins and the inferior vena cava.

Necropsy revealed an old false passage on the right wall of the urethra 1 inch distal to a dense small-caliber stricture. This was the mode of entry of the contrast medium to the vascular system. Barium was found in the coronary arteries, and it is believed that death was due to coronary embolism.

The choice of contrast medium for urethrography is discussed. While lipiodol and the barium suspensions give good contrast, they both present obvious dangers should they enter the blood stream. A medium should be employed, therefore, that could cause no danger to the patient should this rare accident occur. Hippuran and the media commonly used for excretion urography give adequate shadows, and the patient is protected from the dangers described above, although these substances still may have unpleasant sequelae should extravasation into the tissues occur.

A short review of the literature on fat embolism complicating urethrography is included.

One roentgenogram.

## THE BLOOD VESSELS

**The Valsalva Maneuver: An Aid for the Contrast Visualization of the Aorta and Great Vessels.** Norman E. Freeman, Thomas M. Fullenlove, Edwin J. Wylie, and Rutherford S. Gilfillan. Ann. Surg. **130:** 398–414, September 1949.

In an attempt to obtain better radiographic demonstration of the vascular system in both retrograde and direct arteriography, the authors have employed the Valsalva maneuver.

Radiographic visualization of the vascular system requires a high local concentration of dye. In larger vessels, however, where the volume blood flow is great, the injected dye is rapidly diluted and visualization is difficult. By means of the Valsalva maneuver temporary diminution of cardiac output is obtained, permitting injection of radiopaque material into a major vessel containing relatively stagnant blood. When the patient exhales, the return of blood velocity causes the dye to traverse the arterial system as a bolus in sufficient concentration to be visualized in successive radiographs. The technic is discussed and 13 cases are cited with representative roentgenograms.

The procedure is not without attending hazards, and there is a frank discussion of the various complications occurring in the authors' cases.

Those interested in using the procedure would profit by reading this article.

Thirteen roentgenograms; 1 photograph; 1 arterial pressure tracing; 1 table.

HERBERT D. KERMAN, M.D.
Louisville, Ky.

**Pathology and Treatment of the Post-Phlebitic Leg and Its Complications.** Josephus C. Luke. Canad. M. A. J. **61:** 270–275, September 1949.

Despite new methods of treatment, the diagnosis of thrombophlebitis of the deep leg veins is frequently made at a late stage. At the present time we are dealing with the complications of phlebitis which occurred up to thirty years ago. The treatment of

post-phlebitic complications is far from standardized, and the results of therapy leave a great deal to be desired.

The authors discuss a series of 28 cases of post-phlebitic edema associated with ulceration or eczema of the lower leg, in 18 of which retrograde venography was successfully accomplished. This revealed all degrees of venous involvement from valvular damage to almost complete obliteration by organized thrombus, but there was little correspondence between the extent of venous change and the severity of complications. Interference with the lymphatic return is considered the primary factor and venous retardation secondary. The entrance of pyogenic organisms following trauma is the immediate cause of complications.

Cases may be divided into four groups for the purpose of treatment: (1) associated secondary incompetent varicose veins; (2) cases with evidence of sympathetic over-activity in the leg; (3) those with marked soft-tissue sclerosis about the ulcer; (4) a final group in which none of the above factors are present.

The individual must be impressed by the fact that recurrence is inevitable unless he follows a few simple common-sense rules for the continual care of the leg damaged by phlebitis.

Seven roentgenograms.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

## TECHNIC

**Radiographic Technic for the Examination of the Apices.** Enrico Lattanzio. Radiol. med. (Milan) **35:** 723–733, September 1949. (In Italian)

The author has devised a filming fluoroscope which allows the radiographic study of the pulmonary apices with various obliquity of the incident beam. He stresses the importance of studying this area in more than one projection and of casting pathological shadows free of the shadows of the ribs and clavicles.

Eight roentgenograms; 2 diagrams.

CESARE GIANTURCO, M.D.
Urbana, Ill.

**Automatic Roentgen-Ray Roll-Film Magazine for Angiocardiography and Cerebral Arteriography.** Charles T. Dotter, Israel Steinberg, and Harold L. Temple. Am. J. Roentgenol. **62:** 355–358, September 1949.

The authors describe an automatic roll-film magazine for rapid serial radiography which has been developed by them in co-operation with the Fairchild Camera and Instrument Corporation. The unit is compact and makes roentgenograms measuring 9 3/16 × 9 7/16 inches at a rate of two exposures every second. Intensifying screens are pressed against the film during exposure and separated during the period of film transport.

The roll-film magazine weighs only 20 pounds, may be removed for loading and unloading in the dark room, and holds 75 feet of film. The entire unit measures 23 × 21 3/4 × 8 inches. The authors have mounted their unit on a Philips pedestal Bucky stand, on which it may be used in the horizontal, vertical, or intermediate position. A fixed or oscillating grid may be placed over the unit to afford the benefits of grid films when desired.

Four roentgenograms; 2 photographs of the magazine.

PHILLIP B. LOCKHART, M.D.
Indiana University

**A New Apparatus for Direct Cineroentgenography.** Åke S. Gidlund. Acta radiol. **32:** 81–88, Sept. 30, 1949.

A new apparatus for direct cineroentgenography is described in detail. Exposures are made on discontinuously moving film. Each photograph measures 13 × 18 cm. and the roll of film is 5.5 meters in length. The apparatus is motor driven and is capable of making 3.5 exposures per second when a mechanical interrupter is used. The maximum number of exposures without the mechanical interrupter is 5 per second, assuming a time of exposure of 0.1 second.

The method is described as being especially useful in venography, arteriography, and in the study of peristaltic activity.

Ten illustrations.

D. E. VIVIAN, M.D.
Indiana University

## RADIOTHERAPY

**Inoperability versus Incurability in Tumor Management.** S. Gordon Castigliano. Pennsylvania M. J. **52:** 1364–1370, September 1949.

With modern radiation therapy, inoperability does not necessarily mean incurability, for a small but appreciable number of cases can be salvaged with adequate irradiation patiently given, and in other patients worth-while palliation can be obtained. To bring into sharper focus this new group of curable patients and to develop the full picture of cancer therapy today, the author reviews the somewhat parallel development of surgery and radiology. The present abstract will be limited to the latter.

It has been stated that irradiation therapy is not competitive with surgery, but this is not wholly true, since the pioneer radiologist has tried to do a better job with his weapons than the surgeon has been able to do with his. While at times this effort has met with defeat, some fundamental changes have been brought about in the treatment of cases formerly managed by surgery alone. In the management of carcinoma of the skin of the face, labial and oral carcinoma, some pharyngeal and laryngeal carcinomas, and carcinoma of the uterine cervix, not only has irradiation taken over in the operable group, but it has shown itself able to accomplish survivals tantamount to cures in more advanced cases classed as inoperable.

In addition to its role as the dominant agent in these several types of malignant growth, irradiation plays an adjuvant or complementary role in the treatment of operable cases in which surgery is still the method of choice. Preoperative irradiation is used in operable carcinoma of the corpus uteri, metastatic cervical lymph nodes in labio-oral carcinoma, osteogenic sarcoma, certain soft-tissue sarcomas, carcinoma of the breast in borderline cases, and some cortical renal tumors. Postoperative irradiation is of value in carcinoma of the breast, where axilliary lymph nodes have been found and in irradiation of the retroperitoneal lymph nodes in testicular tumors.

There still remain a large number of cases which are candidates for neither curative surgery nor curative irradiation. Such cases may be divided into three groups: (1) those where prolonged palliation is expected, as in metastatic cancer from breast to bone, cancers of the oral cavity, uterus, skin, tumors of testes, some brain tumors, some lymphoblastomas, and some leukemias; (2) those in which only short-term palliation can be attained, as carcinoma of the esophagus, rectum, bronchi, etc.; (3) cases in which no palliation can be had, as in carcinoma of the stomach. Palliation may sometimes be best achieved by the combined use of radiation and testosterone, stilbesterol, or the new polysaccharides. Nitrogen mustard may be used in certain cases, but the effect of teropterine is unpredictable.

Six illustrations, including 3 roentgenograms.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

**Radiotherapy of Accessible Malignant Tumours by Alternating Chess-Board Method.** Benjamin Jolles. Lancet **2:** 603–606, Oct. 1, 1949.

The author describes a new method of radiotherapy of accessible tumors which is a complete departure from all the existing methods in use, in both fundamentals and technical details. With a lead chess-board sieve, with alternate opaque and transparent squares, portions of the tumor 1 cm. square are exposed to radiation while other portions of similar area are protected, so that important structures remain undamaged and can contribute to repair. After a suitable period of treatment, another chess-board sieve, in which the order of opaque and transparent areas is reversed, is used, and the previously untreated areas are exposed while the already treated areas are protected and their recovery not hindered.

Three cases of epithelioma of the skin treated with the chess-board technic are described in detail. Good results were obtained in all.

The treatment is individualized and controlled by histologic study of biopsy material taken at various intervals of time from adjoining areas. The dose of radiation required for the disappearance of the tumor, which is very rapid, is smaller than that employed with methods in which radiation is directed to both malignant and normal tissue alike. The risk of necrosis is lessened to a great extent, and the indirect effect of radiation is utilized. Reactions are mild, and healing takes place during treatment.

Five illustrations.

**Skin Cancer: A Ten-Year Survey in Private Practice.** J. G. Thompson. South M. J. **42:** 805–808, September 1949.

The author presents an interesting tabulation of the number and variety of skin cancers he has observed and treated over a ten-year period. In this interval, 25,000 patients were seen; 3,098, or about 1 in 8, had precancerous or cancerous lesions. The greater number of these lesions occurred in the sixth and seventh decades. Since many of the patients were farmers and lived at a distance, an attempt was made to complete the treatment at one visit, but frequent follow-up examinations were urged. Squamous- and basal-cell lesions numbered 3,331, of which 1,394 were treated with desiccation and curettage and radium, with recurrence in 0.93 per cent as compared with a recurrence rate of 6.66 per cent when x-ray only was used, 3.8 per cent recurrence for desiccation, curettage, and x-ray, and 5.03 per cent recurrence for radium only. Seven hundred and eleven keratoses were removed, almost entirely by desiccation and curettage, and the number of recurrences was negligible.

From this series the author has noted that people in his state (Mississippi) are becoming more cancer-conscious and applying for treatment earlier and consequently with smaller lesions. His impression is that x-ray is the treatment of choice, particularly in view of safety factors. If it is felt necessary, supplemental methods such as desiccation, curettage and/or radium may be employed.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

**Rhabdomyosarcoma of the Middle Ear.** Safa Karatay. Arch. Otolaryng. **50:** 330–334, September 1949.

A case of rhabdomyosarcoma of the middle ear in a 3-year-old Negro girl was treated by radical removal and postoperative roentgen therapy (2,000 r to the tumor region). Recurrence was rapid and radium therapy was without avail. The diagnosis was proved at autopsy.

Three photomicrographs.

**On Roentgen Treatment of Intracranial Gliomas.** Arne Engeset. Acta radiol. **32:** 210–228, Sept. 30, 1949.

The author reviews the history of roentgen therapy for intracranial tumors, going back to early days of massive dosage, when many patients died as a result of the increased intracranial pressure, and discussing the later trend toward smaller doses, usually with a preliminary decompressive craniotomy. Before proceeding to the report of his own material, he quotes at some length, particularly from the American literature, on the various phases of the problem, including irradiation injuries in man and animals.

The series reported comes from the University Hospital of Oslo and comprises about 50 cases. In most instances the tumor was removed in part.

Eighteen patients with glioblastoma multiforme were treated, receiving a total dose of 600 to 10,200 r. The response in this group was generally poor, though slight temporary improvement was noted in some instances. The average survival time was 8.9 months.

Of 12 patients with astrocytoma, 8 were alive at the time of the report after two to fourteen years. All showed some improvement after operation and irradiation, but all had sequelae of some sort (slight epileptic fits, aphasia, cramps, dementia, visual disturbances). The total dose in this group was between 1,360 and 16,150 r (this last dose in a patient with a recurrence). Like others, the author has found these tumors to be more benign than the glioblastomas, but while the patients may survive for a considerable time without treatment, he has the impression that combined surgical and roentgen therapy is useful.

Two cases of astroblastoma were treated. A boy of six was definitely benefited by a total dose of 9,900 r and was in excellent condition after seventy months. A woman of thirty died three years after treatment.

One patient with oligodendroglioma received a dose

of 10,200 r. She was able to work for six months but later declined gradually and died four years after treatment. A second patient with an expanding lesion in the left hemisphere received irradiation alone. She responded well for two years but succumbed to a recurrence.

Several cases of cerebellar medulloblastoma are included in the series. One women was alive eleven and a half years after operation and roentgen therapy (13,995 r through five portals). A number of children received roentgen therapy only, by the method of Sosman (Cutler, Sosman, and Vaughan. Am. J. Roentgenol. **35:** 429, 1936), with encouraging results. A three-year-old girl was well and symptom-free twenty-nine months after treatment.

Six patients with pineal and third ventricle tumors with a previous ventriculocisternostomy showed survival periods of 4.5 to 100 months.

The author describes one case of late irradiation injury. This patient received 30,800 r in sixteen months and twenty-six months later was given supervoltage irradiation of 6,450 r. Postmortem examination showed necrosis in the irradiated area. This the author believes was due to over-irradiation, though cases have been reported in which higher dosages were without ill effect.

The technic employed is described. To avoid side reactions treatments are usually initiated with 25 r daily for four to five days, with a gradual increase so that at the end of two weeks a daily dose of 200 to 500 r is being given. Treatment is started three days after surgery. Factors are 170 kv., 6 ma., and usually a Thoraeus filter; three or four portals are used. In children, the aim is to deliver a tumor dose of 5,000 r or a little less, and the dose per session is from 25 r to 2 × 150 r daily.

Three roentgenograms.

R. C. DATZMAN, M.D.
Indiana University

**Medulloblastoma of the Cerebellum.** Isadore Lampe and Robert S. MacIntyre. Arch. Neurol. & Psychiat. **62:** 322–329, September 1949.

When Bailey and Cushing first segregated the medulloblastoma from the general group of gliomas, the average life expectancy for patients treated by operation alone was about seven months. With improved postoperative radiation technics the average survival has been increased to two or three years. Review of the literature indicates that there are approximately 27 patients who have survived more than three years. Of these, apparently 12 were alive three to nine years after treatment, presumably without clinical evidence of disease.

Since 1938, twenty-five patients with medulloblastoma of the cerebellum have been treated at the University of Michigan Hospital by a standard technic of postoperative irradiation. All patients were subjected to operation, the procedures varying from biopsy to gross total removal of the tumor.

The scheme of irradiation was designed (1) to irradiate the entire cerebrospinal axis in segmental fashion, beginning with the primary site, (2) to deliver a moderately large dose to each area, and (3) to complete treatment of each area in a relatively short time. The posterior half of the skull was irradiated through two fields, the inferior borders of which extended onto the posterior surface of the neck. The anterior half of the skull was treated through two lateral fields. The spinal axis from the inferior margin of the occipital fields to the coccyx was divided into three fields, 7 to 12 cm. wide.

The fields covering the posterior half of the skull were treated daily (250 r to each of two fields) until a dose of 1,750 r per field was attained. The anterior half of the skull was then treated in the same fashion to the same total dose. The third segment, the upper two spinal fields, was treated next at the same daily rate to the same total dose. The lowest spinal field was treated by itself for the next seven days. In a few patients the dose to the posterior skull fields was increased to 2,000 r or more by alternating treatment to them on successive days along with irradiation of the lowest spinal segment. The entire treatment required four and one-half weeks. The voltage was 200 kv. (Villard circuit), the half-value layer 0.9 mm. of copper, with added filtration of 0.5 mm. of copper and 0.1 mm. of aluminum, the distance 50 cm.; the output was about 50 r a minute measured in air.

Of the 25 patients treated, 18 are dead. Seven (28 per cent) are alive, thirty-three, forty-seven, fifty, seventy, seventy-two, eighty-three, and ninety-two months. With one exception, the surviving patients are in good health. The patient living ninety-two months suffered from intermittent headaches for the first four years, and for the last three and one-quarter years has had intermittent convulsions. Despite this, the authors do not believe that the neoplasm has recurred, since experience with the patients who died has shown that death takes place shortly after symptoms of recurrence develop. No patient in whom recurrence or metastasis developed has remained alive even though additional radiation treatment was given.

Two illustrations; 1 table.

JOHN R. HANNAN, M.D.
Cleveland, Ohio

**Intraoral Mucous- and Salivary-Gland Mixed Tumors.** Andreas Hobæk. Acta radiol. **32:** 229–247, Sept. 30, 1949.

Thirty-three intra-oral mucous- and salivary-gland tumors seen at Det Norske Radium Hospital (Oslo) between 1932 and 1945 are reported. Eight times as many extra-oral tumors of this type were treated during the same period.

The epithelial nature of mucous- and salivary-gland tumors is accepted, but their genesis has not yet been determined. They may represent embryonal branchial anlage or possibly misplaced elements of the notochord. The most common theory is that they arise from fully developed glandular epithelium, which penetrates into the connective tissue and through secretion of mucus causes the latter to change into myxomatous tissue; this, through organization, becomes the so-called chondroid tissue.

The author devotes considerable space to the classification of these tumors. He prefers that of Ahlbom and Reuterwall (Ahlbom: Acta radiol., Suppl. 23, 1935): (1) so-called mixed tumors; (2) adenoma; (3) papillary cystic adenoma; (4) basaloma, (*a*) predominantly cylindromatous or (*b*) predominantly solid; (5) predominantly epidermoid cancer; (6) slightly differentiated or undifferentiated epithelial tumor; (7) fibromyxosarcomatous tumor (without definite epithelial structures). The first three groups are sub-

divided into benign, semimalignant, and malignant types.

The present series is reviewed in a table giving for each case the sex, age, localization, histology, therapy, metastasis, recurrence, and results of treatment. Seventeen of the tumors were in the hard palate and 5 in the soft palate. Metastases in regional lymph nodes were demonstrable in 2 cases in the series and were suspected in several others. There were 7 recurrences.

Treatment was surgical excision followed by irradiation, or occasionally, by choice or of necessity, irradiation alone. External roentgen or teleradium therapy, intra-oral roentgen irradiation, interstitial and surface radium applications were used; 3,500 r to each of two or three external ports or through an intra-oral cone was usual. Treatment factors were 175 kv., 4 ma., 2 mm. Cu filter, 40–50 cm. distance. The daily dose was 250–300 r.

Contrary to the general belief, some of these tumors are relatively radiosensitive. Basalomas and fibroepithelial types are moderately radiosensitive, and particularly the tracheal salivary gland tumors.

The prognosis in semimalignant or malignant forms of mucous- and salivary-gland tumor is comparatively good, particularly with operation followed by roentgen irradiation. Of the present series, 13 were treated solely by irradiation and 6 patients were alive without recurrence after three to ten years. Fifteen of 20 patients treated both operatively and radiologically were free of disease after similar periods. Two of the cases presented here became operable after irradiation.

Metastases occur late and are noted first in the regional lymph nodes and then in the lungs, pleura, and bones. A patient may have active malignant disease for years before succumbing.

Thirteen illustrations; 3 tables. J. S. SCOTT, M.D.
Indiana University

**Cancer of the Breast.** Brian W. Windeyer. Am. J. Roentgenol. **62:** 345–349, September 1949.

The author reports a series of 1,091 cancers of the breast seen at the Middlesex Hospital, London in 1936–1942: 917 patients had no previous treatment, and 114 were referred for postoperative roentgen therapy after surgery elsewhere. The 917 cases were staged according to the Manchester classification. In general, radical mastectomy was used in Stage I; radical mastectomy with postoperative roentgen therapy in Stage II and most Stage III cases; x-ray or radium therapy, alone or associated with conservative surgery, in the remainder of Stage III and in Stage IV cases.

Postoperative roentgen therapy was given at 220 kv., with a half-value layer of 2.1 mm. of copper. The entire chest wall on the operated side was treated through two opposing tangential fields. The axilla, retroclavicular, and supraclavicular regions were treated through two opposing and posterior fields. The total dose given was 2,500 to 3,500 r, delivered over thirty to thirty-five days.

Results in terms of five-year survivals were: Stage I, 62.7 per cent; Stage II, 34.7 per cent; Stage III, 28 per cent; Stage IV, 8 per cent. The five-year survivals in cases referred for postoperative x-ray therapy were the same as for the author's own operable cases, 42.9 per cent.

Difficulties in giving adequate roentgen therapy after radical mastectomy are discussed. The author suggests changes in treatment policies which his experience in borderline operable cases seems to justify: (1) radiotherapy alone for *all* inoperable cases except for very conservative surgery; (2) preoperative roentgen therapy for *all* operable cases, followed by radical mastectomy. True Stage I lesions should do well with radical surgery alone. However, since early metastases cannot be ruled out by clinical examination alone, it seems logical to advocate preoperative roentgen therapy in all operable cases.

Two tables. O. RAYMOND RUSSELL, M.D.
Indiana University

**Cancer of the Breast.** H. Glenn Bell. Ann. Surg. **130:** 310–313, September 1949.

The author reports 819 cases of carcinoma of the breast seen at the University of California Medical Center from July 1, 1930, to Jan. 1, 1944. In 83 cases no treatment was given at the Center, but the patients were followed. The remaining 736 patients had some form of definitive or palliative treatment. The over-all five-year survival rate for the series of 819 patients was 32.2 per cent. There were four operative deaths among 470 primary surgical cases, a mortality of 0.85 per cent.

In further analysis of these cases, the author uses Schenck's clinical classification. Of the 173 patients classed as Stage I, 61.8 per cent survived five years or more regardless of the type of treatment. The five-year survival rate for the 201 patients in Stage II was 39.8 per cent, and for the 203 patients in Stage III, which was made up of all the advanced primary cases, 8.3 per cent. Stage IV, consisting of 106 patients with recurrence of a carcinoma that had been operated upon elsewhere, showed 22.6 per cent living and well five years or more after treatment. In Stage V, the group who had surgery elsewhere followed by roentgen therapy at the University of California Hospital, there were 53 patients living and well over five years, or 39 per cent. Of Stage VI patients, those followed in the author's clinic after treatment elsewhere, 15 (18 per cent) lived five years without recurrence.

Combining Groups I, II, and III, 203 patients were treated by radical surgery alone and, of these, 53.6 per cent were living and well five years and longer. Of 80 patients who had radical surgery plus preoperative x-ray therapy 41.2 per cent, and of 75 patients who had radical surgery and postoperative x-ray therapy 36.0 per cent, were living and well after five years. One hundred and five patients had roentgen therapy alone, which in most cases was palliative, and of these only 2.8 per cent survived without disease for five years.

Statistically, the possible benefits of roentgen therapy are not reflected in the five-year survival rates. In Stage I, the highest rate was in those patients who had radical surgery alone. In Stage II, the slightly higher survival rate with the use of preoperative x-ray was thought to be probably of no significance (radical surgery alone, 40 per cent; radical surgery plus preoperative irradiation, 41.8 per cent). In Stage III, the use of radiation resulted in a somewhat larger percentage of five-year survivals. In this group, of 14 patients who had simple mastectomy plus postoperative roentgen therapy, 21.4 per cent were living and well five years later, as compared with 16.6 per cent of patients who had radical surgery alone.

The author concludes that roentgen therapy as an adjunct to the surgical treatment of carcinoma of the

breast did not significantly increase the five-year survival rate.

Six charts. WILLIAM H. SMITH, M.D.
Louisville, Ky.

**Roentgen Therapy as the Sole Method of Treatment of Cancer of the Breast.** F. Baclesse. Am. J. Roentgenol. **62:** 311–319, September 1949.

The use of roentgen therapy as the sole method of treatment of cancer of the breast is based on observations in cases receiving preoperative irradiation. In a correlation of the five-year results and histopathologic findings in 58 such cases it was found that in those in which the tumor was sterilized, or almost sterilized, there was no local recurrence. Only in advanced cases in which the histopathologic changes were not marked was recurrence observed, invariably in association with distant metastases. Five postoperative deaths occurred in this latter group.

In the Curie Foundation, Paris, from which this report comes, an increasingly higher percentage of cases of mammary cancers is being treated by roentgen irradiation alone. In a series of tables the author presents the one-, three-, and five-year results of such treatment to the primary lesion, axillary lymph nodes, and supraclavicular nodes. A further series of tables analyzes the results according to stages (clinical). These should be consulted in the original. Among 52 cases of Stages II, III, and IV (including cases with distant metastases), available for five-year results, clinical disappearance of the tumor was obtained in 9. In an equal number of cases with axillary lymph nodes 3 to 5 cm. in diameter, there was clinical disappearance of the nodes in 10 at the end of three to five years. In the presence of supraclavicular nodes the survival rate was found to diminish markedly in the year following irradiation not because of supraclavicular recurrence but as a result of distant metastases. In only 3 instances was clinical disappearance of the nodes verified after five years, and in none of these had the nodes originally exceeded 3 cm. in diameter.

The treatment factors are as follows: 180 kv., 1.0 mm. Cu filter, 60 cm. distance, 20 r per minute. The average number of fields is six to seven, the size varying from 10 × 10 to 12 × 10 cm. Treatment is fractionated over three or four months. Clinical disappearance of the lesion was more common after tumor doses of 6,000 to 6,800 r for the primary tumor and 6,000 to 7,000 r to the axillary nodes. For the supraclavicular nodes the skin dose is at least 4,500 to 5,200 r, and a single field is used.

Four illustrations; 11 tables.

J. G. LORMAN, M.D.
Indiana University

**Treatment and Results in Cancer of the Breast.** Elis Berven. Am. J. Roentgenol. **62:** 320–325, September 1949.

Breast cancers treated at the Radiumhemmet, Stockholm, are graded clinically according to Steinthal's method of staging. Since, however, clinical judgment of the stage is often erroneous, and since the survival rate in the Stage III cases has shown notable improvement with preoperative irradiation, it is considered imperative to employ both preoperative and postoperative roentgen therapy for all patients.

Results are reported for two periods, 1921–1935 and 1936–1941. For 1921–1935 the five-year cure rate was 42 per cent and the survival rate 46 per cent; for the later period the corresponding figures are 43 and 57 per cent. A reliable comparison between the results in cases receiving both preoperative and postoperative irradiation and those given postoperative irradiation alone is possible in the cases treated between 1936 and 1941. In Stage I cases no difference was observed, the five-year survival figure being 66 per cent in each group. In Stage II the difference was still "not statistically fully significant," 43 per-cent survivals with both pre- and postoperative irradiation and 36 per cent with postoperative therapy alone. In Group III, however, the value of preoperative irradiation was definitely demonstrated; the survival rate for 91 patients receiving preoperative and postoperative roentgen therapy being 31.9 per cent as compared with 6.7 per cent for 30 patients in whom preoperative therapy was not given.

The plan of therapy and factors employed are given. Women in the reproductive age are routinely given a castration dose of radiation to the ovaries.

Five tables. M. M. MANALAN, M.D.
Indiana University

**Carcinoma of the Cervix Uteri.** William S. Baker. U. S. Nav. M. Bull. **49:** 868–877, September–October 1949.

After a discussion of diagnosis and treatment of invasive and non-invasive carcinoma of the cervix, the author outlines the procedure followed in his own institution. A combination of radium and high-voltage roentgen therapy is used. No data on the number of patients treated or survival rates are given.

**Report on a Series of 129 Cases of Cancer of the Corpus Uteri.** Gertrude Dearnley. J. Obst. & Gynaec. Brit. Emp. **56:** 819–832, October 1949.

At the Royal Free Hospital, London, 129 cases of cancer of the corpus uteri were seen between 1926 and 1943. Thirty-one per cent of the cases occurred before the menopause. Only 56 per cent of the patients were parous. About one-third were unmarried.

Four cases proved to be too advanced for treatment, 50 were submitted to total hysterectomy, and 75, of which 28 were clinically operable, received radium therapy. For the entire series the absolute five-year cure rate was 56.6 per cent, for the surgical group, 72.2 per cent, and for the radium-treated group 45.2 per cent. If, however, only the clinically operable cases are considered, the figures are more closely comparable: for 39 cases treated solely by operation, 78 per cent, and for 21 treated by radium alone, 75 per cent.

While the author does not feel that so small a group justifies conclusions, she favors surgery where possible.

[The trend in the United States is toward a combined method of attack. Only a few of the patients in this series received preoperative irradiation.]

Fourteen tables. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

**Carcinoma of the Vulva. Symposium. I. The Treatment of Cancer of the Vulva.** Elis G. E. Berven. **II. Radium Implantation Treatment of Carcinoma Vulvae.** Margaret C. Tod. **III. Cancer of the Vulva Treated by Radiation: An Analysis of 127 Cases.** Frank Ellis. Brit. J. Radiol. **22:** 498–520, September 1949.

*Berven* reports the results of treatment of vulvar carcinoma from numerous sources, showing that

surgical methods give an average five-year relative survival rate of 22 to 25 per cent. Radiological treatment yields only 12 per cent five-year survivals, and the rate for combined methods is only a little better. These unfavorable results are the consequence of various factors: the disease is predominantly one of old age when the tissues have little reparative power and the patient is not in good physical condition; large areas of tissue are frequently involved, including the urethra and perineum; there is frequent complicating infection, and metastasis usually occurs early.

At the Radiumhemmet (Stockholm) between 1915 and 1921 only radium and roentgen-rays were used for the treatment of vulvar carcinoma, with a primary healing of 20 per cent and a five-year survival of 13 per cent. Treatment was administered by surface contact application of radium; the node-bearing areas were treated by roentgen rays, and dissection was performed if clinical metastases appeared. Since 1921 electrocoagulation has been used, followed by teleradium treatment of the node-bearing areas. The technic is described in considerable detail, and the results are evaluated. The cases are classified as follows: Stage I. No clinical metastases, 43 per cent of the series. Stage II. Operable clinical metastases present, 45 per cent. Stage III. Inoperable metastases present, 12 per cent.

In Stage I teleradium therapy is started at the end of the first postoperative week, each of four fields—two in each groin—receiving about 2,700 to 3,600 teleradium r. The patient is then followed carefully for six months. If any undiscovered metastases are present they will usually appear within that time. If they occur, block dissection is done; otherwise, the patient is followed two to three times a year from then on.

Stage II cases are similarly treated. If the metastases disappear, the patient is followed regularly. If they persist, block dissection is done.

Stage III cases are given 4,500 r teleradium treatment. In a few cases the metastases become operable, in which case an *en bloc* dissection is done.

The prognosis depends primarily upon the spread of the tumor. For purposes of interpretation the three stages are further classified into four groups: I. Small non-ulcerating tumor confined to one part of the vulva. II. Same degree of spread but ulcerating. III. Infiltration of larger parts of the vulva. IV. Infiltration of surrounding tissues, perineum, vagina, urethra, etc.

In Group I there is an average five-year survival of about 80 per cent; in Group II, 47 per cent; in Group III, 50 per cent; in Group IV, 17 per cent. For stages the rates were: Stage I, 60 per cent; Stage II, 27 per cent; Stage III, 14 per cent.

Forty-one illustrations and one table accompany this paper.

*Tod* considers the vulva a poor field for radiotherapy but believes that in cases unsuitable for surgery, radiation offers a reasonable alternative. In the Holt Radium Institute (Manchester,) radium is used in preference to x-rays. The technic of implantation is described and illustrated by eight roentgenograms. The results in 116 cases are tabulated as follows:

| Cases Treated | Well After 5 Years | Alive After 5 Years |
|---|---|---|
| Early cases, 71 | 26% | 33% |
| Late cases, 45 | 14% | 14% |
| Total cases, 116 | 21% | 25% |

Those alive at five years but not symptom-free have since died of cancer, and in 2 listed as well at five years new malignant lesions developed in the unhealthy tissues of the vulva, where pruritus and leukoplakia had been present for many years.

Ellis presents an elaborate analysis of 127 cases of vulvar cancer treated by radium, x-rays, and surgery, alone or in combination, at the Sheffield Radium Center. More than half the cases were treated in the first instance by radium, with a five-year survival rate of 26 per cent and a ten-year survival of 11 per cent. Sixteen per cent were symptom-free for five years, and 11 per cent for ten years. Survival figures for radium and surgery were similar, being rather in favor of radium up to ten years. Of 13 patients treated by x-rays alone, none survived three years free of cancer.

Of the patients who died, 41 per cent still showed cancer in the vulva and 32 per cent in the lymph nodes, when treatment had been by radiation only. For those treated surgically, the corresponding figures were 31 and 31 per cent.

In cases where only radiation treatment was given to the lymph nodes, 53 per cent died with metastases in the nodes; with surgery, the figure was 20 per cent.

Recurrences were more common after radium than after surgery, but radium was more successful in dealing with "surgery recurrences," as was surgery in dealing with "radium recurrences."

Necrosis, when it occurred, seemed more likely to follow radium therapy of the posterior than of the anterior half of the vulva. A technic is described which seemed less likely to cause this complication. The method obtains the effect of two planes of radium by use of a single source in the vagina and a plane occupying the surface of a sphere of which the single source is the center. The distance between the two sources is 4 cm.

Eighteen tables are included.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

**Wilms' Tumor: A Review of Five Year Survivals in the Literature and Report of Two Cases.** Harry Q. Gahagan and H. M. Yearwood. J. Urol. **62:** 295–299, September 1949.

The literature on Wilms' tumor is reviewed, with emphasis on the methods of treatment and the number of five-year survivals. These data are presented in table form. Thirty-three proved five-year survivals were found, and the authors add two of their own with case reports and photomicrographs of tissue sections.

The largest number of five-year survivals followed nephrectomy alone. A single cure was reported following irradiation alone (Nesbit and Adams: J. Pediat. **29:** 295, 1946).

JOHN F. GIBBONS, M.D.
University of Pennsylvania

**Pregnancy in Hodgkin's Disease.** John C. Brougher. West. J. Surg. **57:** 430–434, September 1949.

A review of the literature on pregnancy in Hodgkin's disease is given, with a report of another case, with birth of a full-term normal infant. Roentgen therapy caused a diminution of lymph node enlargement in the patient's neck and chest, followed by recurrence. The author believes that the course of disease was not appreciably influenced by the pregnancy.

Two roentgenograms; 1 photomicrograph.

C. R. PERRYMAN, M.D.
Baton Rouge, La.

**Syringo-Encephalomyelia. Discussion of Related Syndromes and Pathologic Processes, with Report of a Case.** Homer D. Kirgis and Dean H. Echols. J. Neurosurg. **6:** 368–375, September 1949.

Syringo-encephalomyelia is a disease process of unknown etiology, consisting in a cystic cavity in the brain stem or spinal cord with gliosis in the adjacent tissue. The syndrome most commonly found in patients with syringomyelia is due to a deeply placed lesion in the cervicothoracic region involving, first, fiber tracts crossing or adjacent to the midline and later extending peripherally, usually in the posterior or lateral funiculi. There often is evidence of destruction of the anterior column of gray matter. A similar lesion in the brain stem frequently will cause damage to the nuclei and conduction pathways near the floor of the fourth ventricle.

A case of a 12-year-old boy with syringo-encephalomyelia is reported. The cystic cavity was aspirated and a defect was made in its posterior wall. During the second postoperative week roentgen therapy was begun, the physical factors and dosage of which are not specified. The patient's response was favorable at first, but within four weeks after surgery his condition had deteriorated to the preoperative level. At a second operation a permanent communication between the cyst cavity and subarachnoid space was produced by the use of a drain made of tantalum sutures. This was followed by a slow and steady improvement.

On the basis of this case the authors conclude that the only satisfactory method of treatment is by the production of a permanent communication between the cystic cavity and the subarachnoid space.

One diagram. HOWARD L. STEINBACH, M.D.
University of California

**The Sturge-Weber Syndrome. Report of a Case Showing Improvement after Radiotherapy.** Christopher Strang. Edinburgh M. J. **56:** 409–414, September, 1949.

The outstanding signs of the Sturge-Weber syndrome are: (1) a port-wine nevus on one side of the face; (2) calcification in the occipital region of the brain on the same side; (3) neurologic manifestations of the intracranial lesion. The case reported is that of a 15-year-old girl, with a history of increasingly severe convulsions. Shortly after birth, screaming fits occurred, chiefly at night, and continued regularly until the child was three years old. At three months of age, she had an attack of trembling in the left hand and foot, and at four months a convulsion involving the whole body, lasting two and a half hours. Following this, attacks of twitching occurred twice or three times daily. No mental retardation was noticed up to five years of age. For a time, at the age of seven years, phenobarbitone had a beneficial effect. After the age of twelve, the fits steadily increased in severity and, from being jacksonian in type, they became major epileptic attacks with loss of consciousness and urination. From the age of fourteen on, a major epileptic attack was an almost daily occurrence.

When seen by the author, the patient presented the typical and complete form of the Sturge-Weber syndrome. Her mentality was childish and she was high-strung and quarrelsome. Roentgenograms of the skull showed fairly extensive calcification of the convolutions over the right occipital and parietal lobes and a diminution in the volume of this part of the brain.

Under treatment with phenobarbitone, the attacks decreased to two or three times a day. A course of deep x-ray therapy to the intracranial lesion was then decided upon, and a total of 3,200 r was administered to three fields (right lateral, vertex, and occiput) over a twenty-two-day period. The condition seemed to deteriorate, and the patient continued to have one or two epileptic attacks each day. Approximately ten months after the radiotherapy she had a series of severe convulsions, one after the other, following which she was unable to pronounce words or swallow properly for several days. Steady improvement then ensued, and up to the time of the report, a period of ten months, there had been no major epileptic attack, the only epileptic manifestation being an occasional trembling and tenseness of the left hand. Physical examination showed little difference from the original findings, but the patient was quiet and her emotions seemed better controlled. A roentgenogram of the skull revealed a slight increase in the extent of the calcification in the occipital and parietal areas of the cortex.

The author discusses the part played by the radiotherapy in bringing about the dramatic improvement. He suggests that possibly, as a result of irradiation, a large part of the hemangioma clotted, thus cutting off the epileptic focus and leading to an infarcted area of brain in the right hemisphere.

Two roentgenograms; 2 photographs.

**Roentgen Therapy of Hyperthyroidism.** Anibal I. Lemos Ibáñez Prensa méd. argent. **36:** 1840–1846, Sept. 16, 1949. (In Spanish)

The author believes that the treatment of hyperthyroidism by the roentgen ray is perfectly logical and without risk to the health of the patient. In general, younger patients, in whom the disease is not of long duration, respond better and more quickly. On the contrary, older persons with a long history of hyperthyroidism respond slowly and sometimes not at all.

The author employs 190 to 200 kv., a filter of 1.0 mm. Cu plus 1.0 mm. Al, 8 to 10 ma., a focus-skin distance of 40 cm. Treatment is given through a single anterior field, 8 × 10 cm., including both lobes and the superior sternal region, 200 to 220 r being administered every five to seven days, totaling 800 to 1,100 r per series. This series is repeated after two months or more. Usually not more than five series are administered.

JAMES T. CASE, M.D.
Chicago, Ill.

**Evaluation of Hormonal and Radiation Therapy in 190 Cases of Functional Sterility and Secondary Amenorrhea. Preliminary Report.** Rita S. Finkler. Am. J. Obst. & Gynec. **58:** 559–564, September 1949.

Most authors agree that the male is at fault in about 40 per cent, the female in about 50 per cent, and both partners in about 10 per cent of infertile marriages.

The authors in this instance review 130 cases of functional sterility and 60 cases of secondary amenorrhea in an effort to evaluate the relative merits of hormonal and radiation therapy: 108 patients received endocrine therapy, and 82 cases radiation therapy.

The diagnosis of functional sterility is established after a thorough physical examination and completion of laboratory investigations involving specific tests, including endometrial biopsies, vaginal smears, basal temperature graphs, and the estimation of urinary gonadotropins. Treatment is then instituted according

to a definite plan. Thyroid medication is given if indicated and dietary adjustments are made, supplemented with vitamins. If no results are obtained, hormonal therapy is instituted, and if there is still a lack of response, radiation therapy is administered.

The authors use a modification of Kaplan's original irradiation technic. The factors are as follows: 200 kv., 0.6 mm. copper and 1.0 mm. aluminum filtration, 50 cm. target-skin distance, h.v.l. 1 mm. of copper. The ovarian portals measure 8 × 10 cm., the pituitary portals 6 × 8 cm. Four treatments are given over a two-week period. The skin doses are so calculated as to deliver 80 r into each ovary and into the pituitary gland.

In functional sterility, conception took place in 34 per cent of 76 patients treated only with hormones, and 35 per cent of 54 treated with radiation. Of the 54 irradiated patients, 37 had had previous endocrine therapy without result, and 12 of these, or 32.5 per cent, conceived following irradiation, while of 17 patients who had not been given endocrine therapy, 8, or 47 per cent, conceived.

Of 20 patients who conceived after radiation therapy, 9 were pregnant within two months. The promptness with which conception followed therapy demonstrates that the success is not a coincidence.

In secondary amenorrhea, periods were re-established in 40 per cent of patients treated with hormonal therapy and in 46 per cent of patients treated with radiation therapy.

Three tables.

ROBERT LEAMING, M.D.
Jefferson Medical College

**Irradiation of the Nasopharynx and the Prevention of Deafness.** Donald F. Proctor. Ann. Otol., Rhin. & Laryng. **58:** 824–836, September 1949.

The author adds another to his series of papers on the experiences of the Hagerstown (Maryland) Clinic for the treatment of deafness (see, for example, Arch. Otolaryng. **45:** 40, 1947. Abst. in Radiology **49:** 761, 1947), outlining the general program and presenting the indications for irradiation. This form of therapy should be confined to patients with symptoms clearly traceable to the presence of infected adenoid tissue. There has been severe criticism of this method as delivering a dangerously large dose of radiation to the patient and as involving a possible carcinogenic effect. As to the former, the author points out that he never uses as much as the erythema dose calculated by Burnam for mucous membrane and that careful observations over a period of twenty-five years have failed to show any instance of damage attributable to the treatment. He believes that there is no reason to fear a carcinogenic effect but advises against increase in the present dosage and giving more than two or at the most three courses of irradiation.

Eleven tables.

**Radium and the Lymphoid Tissue of the Nasopharynx and Pharynx. A New Universal Applicator.** Wallace Morrison. Arch. Otolaryng. **50:** 300–308, September 1949.

The rationale, the technic, the purposes and the contraindications, the abuses and the dangers of the employment of the standard Monel metal radium applicator for the elimination of lymphoid tissue in the nasopharynx are briefly discussed.

A new type of flexible applicator is described by which practically any area of the nasopharynx can be easily reached for accurate dosage. The instrument can also be used to apply radiation to the lateral pharyngeal lymphoid bands and patches with accuracy and ease.

Six illustrations.

## RADIOISOTOPES

**Treatment of Toxic Goiters with Radioactive Iodine.** Earle M. Chapman and Robley D. Evans. M. Clin. North America **33:** 1211–1223, September 1949.

During the past six years the authors have used radioactive iodine as the single therapeutic agent for 200 patients with toxic goiters, both diffuse and nodular. Sixty-five of this number, with diffusely hyperplastic thyroids, were treated between March 1943 and January 1947 with the isotope $I^{130}$, which has a half life of only twelve hours; 135 patients were treated with $I^{131}$, with a half life of eight days, from the summer of 1946 until June 1949. All these patients continue to be followed at regular intervals, and nearly all of them have responded to treatment and remain well.

No clear indications against the use of radioiodine are known, although the authors advise against its use beyond the fourth month of pregnancy.

This method of internal radiation therapy has been particularly helpful in thyrocardiac patients and has often restored the heart to normal function. Patients with severe eye signs have been greatly benefited.

Patients with hyperthyroidism who are taking iodine should omit such treatment at least twelve days before receiving radioactive iodine; those taking thiouracil should omit the drug four days before receiving radioiodine. In the authors' experience there is rarely a need to give antithyroid drugs subsequent to radioiodine therapy.

After eight years experience with this method of treatment and after histologic study of thyroid tissue removed nineteen days to five and one-half years after the administration of radioactive iodine, the authors believe there is no evidence that therapeutic doses are carcinogenic.

**Rate of Conversion of Administered Inorganic Radioactive Iodine into Protein-Bound Iodine of Plasma as an Aid in the Evaluation of Thyroid Function.** Dwight E. Clark, Robert H. Moe, and Evelyn E. Adams Surgery **26:** 331–340, September 1949.

Urinary excretion and direct measurement over the thyroid gland have been the two methods used in following the uptake of radioactive iodine in the normal and abnormal thyroid, but it has been shown that there is poor correlation between the thyroid uptake as determined by these two procedures. The present paper deals with the rate of conversion of orally administered inorganic radioactive iodine into protein-bound iodine in the plasma as a guide to thyroid activity. The studies were carried out on patients with various thyroid states and patients with hypertension and cardiac disease with an elevated basal metabolism rate. The results are expressed as the ratio of radioactivity in counts per second in the protein fraction to the total plasma radioactivity in counts per second.

$$\text{Conversion ratio} = \frac{\text{Protein-bound } I^{131} \text{ in } c/s}{\text{Total plasma } I^{131} \text{ in } c/s} \times 100$$

Each patient was given a careful individual evaluation particularly with reference to previous medication or laboratory procedure which may have involved the use of iodine. In patients with unquestionable hyperthyroidism the conversion ratio ranged from 45 to 96 per cent with an average of 78.5 per cent. Only one patient had a conversion ratio of under 50 per cent. This patient had received propylthiouracil only two weeks prior to the test. It is believed that at least four weeks should elapse between the last dose of propylthiouracil and the test. There was definite correlation between the clinical severity and the conversion ratio, the percentage being higher in the more severe disease. All patients with a ratio of over 50 per cent were considered as having hyperthyroidism. In normal patients conversion ratio ranged between 13 and 42 per cent with an average of 24 per cent, and in hypothyroidism the range was from 2.7 to 12.5 per cent with an average of 6 per cent. In a case of acute thyroiditis with a normal basal metabolism rate there was a normal conversion ratio. In marked cardiovascular disease with hypertension the conversion ratio was under 10 per cent placing these patients in the hypothyroid range. In 2 patients with essential hypertension the ratio was 36 and 23.8 per cent, respectively, *i.e.*, in the normal range. Age does not seem to effect the conversion ratio. There is no overlapping between hyperthyroid and euthyroid groups, such as occurs with urinary excretion studies.

From 1.0 to 1.5 millicuries of radioactive iodine were used in order to obtain significant counts in 1 c.c. of plasma. Crile, McCullagh, and Glasser have estimated that 30 millicuries would be necessary to cause hypothyroidism in a patient with a normal gland (Cleveland Clinic Quart. **16:** 1, 1949).

Two graphs; 4 tables. J. E. WHITELEATHER, M.D.
J. E. GARDNER, M.D.
Memphis, Tenn.

**Urinary Excretion of Radioactive Iodine as a Diagnostic Aid in Thyroid Disorders.** A Stuart Mason and R. Oliver Lancet **2:** 456–460, Sept. 10, 1949.

**Urinary Excretion of Radioactive Iodine as a Diagnostic Test in Thyroid Disease.** D. G. Arnott, Russell Fraser, E. W. Emery, and Q. J. G. Hobson. Ibid., pp. 460–465.

Mason and Oliver consider the estimation of urinary excretion of radioactive iodine, $I^{131}$, administered by mouth, a valuable diagnostic aid in thyroid disease. The method is safe enough to justify its use as a routine procedure. A dose of 10 microcuries was found sufficient and is recommended as a maximum for this investigation.

Measurement of excretion in bulked urine samples collected between the sixth and twenty-fourth hour after administration of $I^{131}$ provides a reliable test for thyrotoxicosis. In the authors' series an excretion of under 4 per cent during this period indicated definite thyroid overactivity, excretion of 10 to 25 per cent occurred in normal people, and over 25 per cent was typical of myxedema.

Plotting of the urinary excretion curve and derivation of the thyroid-rate factor as suggested by Keating (J. Clin. Invest. **26:** 1138, 1947) gives a more satisfactory separation of thyrotoxic subjects from normal persons and provides a better estimate of the degree of overactivity than does measurement of a bulked sample. The results in myxedema are of diagnostic value but are less clear-cut.

Four charts.

Arnott and his associates followed the urinary excretion of $I^{131}$ for forty-eight hours after the administration by mouth of a tracer dose of 10 microcuries of $I^{131}$ with 10 mg. of potassium iodide. Thirty normal adults, 26 adults with obvious thyrotoxicosis, and 3 adults with obvious hypothyroidism were studied. There was no evidence of correlation between urinary excretion of the $I^{131}$ and the patient's sex, age, or weight, or with moderate variations in exercise during the test, or with the volume of urine excreted.

Comparison of the three main groups of normal, thyrotoxic, and hypothyroid confirmed previous observations that the rate of fall of urinary excretion rate of $I^{131}$ gives an indirect index of thyroid activity.

Three charts; 3 tables.

**Comparative Value and Accuracy of Measurements of Urinary $I^{131}$ by Beta and by Gamma Ray Counting.** A. Stone Freedberg, Robert Buka, and M. J. McManus. J. Clin. Endocrinol. **9:** 841–851, September 1949.

Two procedures were used for determination of urine $I^{131}$ radiation, by counting the beta and gamma rays, respectively. The *beta method* is the more sensitive, giving counts per microcurie approximately 250 times those obtained by the gamma method. It is the procedure of choice for determinations on blood and serum, for small amounts of radiation, since the gamma technic cannot measure accurately less than 0.25 $\mu$c. When beta rays are counted, correction must be made for mass absorption from urinary solids.

In determination of urinary excretion, when larger amounts of $I^{131}$ are present, the *gamma counting method* is simple and results can be obtained promptly. Mass absorption within the range usually observed in the urine does not have to be considered.

A study of the urinary excretion of $I^{131}$ by the described beta and gamma counting procedures yielded agreement within 5 per cent.

Six charts; 7 tables.

**Behavior of Labeled Iodocasein in Human Myxedema.** C. F. Hamilton, A. Albert, Marschelle H. Power, Samuel F. Haines, and F. Raymond Keating, Jr. J. Clin. Endocrinol. **9:** 828–840, September 1949.

The authors report a study on the distribution and fate of labeled iodocasein at two metabolic levels, in a patient with myxedema: (1) in the hypothyroid state, before treatment, and (2) in a euthyroid state, after adequate treatment of the myxedema with nonradioactive iodocasein. As control data, exactly similar observations were made with labeled sodium iodide in amounts comparable to that of the iodine contained in the iodocasein.

The control studies with sodium iodide indicated that no demonstrable localization occurs in the athyrotic subject, nearly all of the iodide being accounted for in urine or feces. Furthermore, no transformation of iodide was observed, except possibly in the myxedematous state, in which small amounts of radioactivity were found in the protein-bound fraction of serum.

Comparative studies with labeled organic iodine

(radioactive iodocasein) during myxedema and euthyroidism disclosed concentration of radioactivity over the gastro-intestinal tract and liver, a high fecal and a low urinary excretion. As indicated by blood levels of radioactivity and by fractionation studies, iodocasein was rapidly absorbed. Rapid and continous degradation of the material was indicated by the early appearance and persistence of a significant labeled inorganic iodide fraction in serum.

Both iodide and iodocasein were disposed of more rapidly while the subject was in a euthyroid state than in a hypothyroid state.

Three charts; 3 tables.

**Effects of Lipotropic Substances on Phospholipide Synthesis in Patients With and Without Chronic Hepatitis as Measured by Radioactive Phosphorus.** David Cayer and W. E. Cornatzer. South. M. J. **42:** 669–674, August 1949.

The authors discuss the value of dietary supplements, lipotropic substances in particular, in addition to the usual diet high in calories, proteins, and vitamins in chronic hepatitis.

With the use of radioactive phosphorus as an indicator, it had been shown previously that the administration of choline and methionine to experimental animals with fatty livers, induced by diet, increases the rate of phospholipid turnover in the liver and plasma. This led the authors to a clinical study of the effect of lipotropic substances in accelerating lipid synthesis. The turnover of plasma phospholipids, which are derived almost entirely from the liver, was calculated following the intramuscular injection of a solution of sodium phosphate containing 0.5 millicuries of radioactive phosphorus. Blood samples were taken at 0, 24, 48, 72, and 96 hours; the radioactivity and phosphorus in the plasma lipids were determined.

An increase in phospholipid turnover in the plasma was found in untreated human patients with chronic hepatitis following a large dose of choline or methionine. This stimulant effect was not noted in cirrhotic patients after a period of treatment or when small daily doses of lipotropic factors were given, nor was the effect apparent in persons without liver disease or in patients with infectious hepatitis.

The authors' results suggest that there may be a deficiency of lipotropic substances in acutely ill patients with large fatty livers before the advanced stage of cirrhosis is reached.

Three charts.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

**Methods for the Determinations of Radioactive Phosphorus ($P^{32}$) in Body Fluids.** Margaret A. Adams, Stanley M. Levenson, Rex G. Fluharty, and F. H. Laskey Taylor. J. Lab. & Clin. Med. **34:** 1301–1311, September 1949.

The technics developed for the investigation of phosphorus metabolism in man, with $P^{32}$ as a tracer, in doses of 100 to 200 microcuries intravenously, are described. Methods for determination of the amount of radioactive phosphorus in plasma, red blood corpuscles, and urine are given. The authors discuss the separation of the total acid-soluble and inorganic phosphate fractions of plasma and red blood corpuscles and the procedures used for preparing and counting radioactive samples from these fractions.

One illustration; 8 tables.

HOWARD L. STEINBACH, M.D.
University of California

## EFFECTS OF RADIATION

**Radiation Exposures from the Use of Shoe-Fitting Fluoroscopes.** Charles R. Williams. New England J. Med. **241:** 333–335, Sept. 1, 1949.

**Potential Dangers in the Uncontrolled Use of Shoe-Fitting Fluoroscopes.** L. H. Hempelmann. Ibid., pp. 335-336.

These two papers deal with the practice followed by many shoe stores of examining the foot fluoroscopically for fitting purposes. The fluoroscopic unit varies in construction but is essentially a 50-kv. x-ray machine operated at 3 to 8 ma. with 1 mm. aluminum filter, housed in a case lined with lead or steel, containing a fluorescent screen. The distance to the skin varies from 7.5 to 20 cm. The time of exposure is variable, but the average seems to be about 20 seconds. Repeated exposures can be made by a push button. In a study of twelve different units, Williams found the dose on the feet of the customer for a 20-second exposure to vary between 10 and 116 r.

The amount of scatter from these machines amounted to more than 100 milliroentgens per hour at 10-feet distance and 15 mr. per hour at 25-feet distance from the machine. Leakage was measured about the walls of the cabinet and that found at the front was from 3 to 6 mr. per hour; at the sides from 7 to 60 mr. per hour; at the back 6 to 200 mr. per hour; and in viewing positions from 0 to 24 mr. per hour.

Hempelmann considers the potential dangers that may arise from these shoe-fitting fluoroscopes, especially to children, for whom they are so largely used. Early closing of the epiphyses and reduction in the rate of bone growth with resulting malformation may follow exposure to irradiation.

Acute and chronic irradiation reactions of the skin are also potential dangers. It is estimated that between 600 and 1,000 r of soft x-rays given within a day or two can produce serious skin reaction, but there is no published information as to the maximum dosage that can be delivered to the skin with safety at the intervals at which children are likely to be fitted for shoes.

Injury to blood-forming elements in the body is a further possibility.

Various measures for regulation of the use of shoe-fitting fluoroscopes are proposed by both writers.

An editorial comment (pp. 346–347) on these two papers calls attention to the fact that excessive irradiation may be delivered to a child's feet by repeated exposures in one or more stores on the same day, by repeated exposures for various shoes, or even as a result of curiosity on the child's part. An erythema, which may not become evident for a week or two, is probably overlooked and the change attributed to some other irritant. Blood changes and changes in the sex glands are less likely to occur in the customer but the possibility of their occurrence in the sales personnel must certainly be considered.

The editorial suggests that if these machines are necessary for a scientific fitting of the shoe then they must be used under the strictest supervision and their use

severely controlled. If the machines are solely for promotional and advertising purposes, their use should be completely abandoned.

[More recently a statement has been issued by the Federal Security Agency urging voluntary control of shoe-fitting fluoroscopes and urging communities to set up their own controls if such voluntary measures fail.—ED.] JOHN B. MCANENY, M.D.
Johnstown, Penna.

**Preliminary Studies of the Effectiveness of Local Irradiation in the Induction of Lymphoid Tumors in Mice.** Henry S. Kaplan. J. Nat. Cancer Inst. **10:** 267–270, October 1949.

Induction of lymphoid tumors following whole-body exposure of mice to ionizing radiation has been reported by a number of investigators. In sharp contrast to these observations, the author found that local irradiation of mice (strains A and C57 black) by different technics in three related experiments consistently failed to yield lymphoid tumors with significant frequency. It is concluded that the induction of these tumors is probably not solely the result of a simple direct action of radiation upon the susceptible cell or tissue of origin.

Two tables. DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

**X-Radiation of Eggs of Rana Pipiens at Various Maturation Stages.** Grace Saunders Rollason. Biol. Bull. **97:** 169–186, October 1949.

This is a comprehensive and technical paper presenting the results of a study on the effects of different quantities and intensities of roentgen rays upon the embryological development of the eggs of the frog, *Rana pipiens*.

Eight figures; 6 tables.
DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

**Pathology of Atomic Bomb Casualties.** Averill A. Liebow, Shields Warren, and Elbert DeCoursey. Am. J. Path. **25:** 853–1028, September 1949.

The three main types of injuries inflicted by the explosion of the atomic bombs in Hiroshima and Nagasaki were traumatic, thermal, and those due to ionizing radiation. Of these, the ionizing radiation injuries were quantitatively the least important in the production of casualties.

The effects of ionizing radiations resembled those produced by total body x-irradiation of animals and men. These were noted in poorly shielded individuals who were within a mile of the explosion.

Nausea and vomiting occurred within a few hours and severe diarrhea and fever sometimes were present within three days of the explosion. After the end of the second week, epilation and purpura become manifest and infective complications of aplastic anemia became increasingly prominent. Leukopenia had been observed within the first few days after the bombing. After the sixth week the bone marrow tended to recover.

At necropsy there were suggestive epithelial changes at the margins of ulcerative lesions of the skin in patients dying during the third week. Epilation usually began after two weeks. Typical radiation changes with the formation of bizarre cells were seen in the intestines of persons dying as early as the fourth day.

On the fourth day remarkable changes were found in the testes, progressing until the end of the first month, when there was almost complete loss of the germinal epithelium. "Castration cells" were found occasionally in the pituitary. The findings in the ovaries were much less striking, usually an absence of developing follicles, with persistence of primary follicles, was present.

The lymphoid tissue, three days after exposure, showed a remarkable degree of atrophy, nothing but the reticular skeleton remaining. Beginning on the fifth day, atypical cells began to be seen and in a few instances secondary follicles had reappeared within three months.

Within the first week almost all myeloid and erythroid tissue in heavily irradiated persons had disappeared, but there already was evidence of proliferative activity on the part of the reticulum cells. In some patients, after various lengths of time, there was renewed differentiation into granulopoietic and erythropoietic tissue, and in some actual hyperplasia of this tissue was observed. As the marrow recovered, polymorphonuclear leukocytes became numerous in the lesions and hemorrhage ceased to be an important factor. The important lesion, after the sixth week, was either a necrotizing pneumonia or an ulcerative enteritis. Thrombocytopenia was at its lowest level at about the third to fourth week; thereafter there was rapid recovery. Anemia became increasingly prominent after the third week.

One hundred and forty-three figures.
HOWARD L. STEINBACH, M.D.
University of California

**Response of Tissue to Total Body Irradiation.** John L. Tullis. Am. J. Path. **25:** 829–851, September 1949.

The material contained in this paper has previously been covered in a report from the Naval Medical Research Institute (Bethesda, Md.), abstracted in Radiology **53:** 468, 1949.

Thirty-five figures.

**Operation of a 300 Mev Betatron.** (Letter to the Editor.) D. W. Kerst, G. D. Adams, H. W. Koch, and C. S. Robinson. Phys. Rev. **78:** 297, May 1, 1950.

The new betatron of University of Illinois at Urbana was run successfully at 315 Mev on first operation, giving 1,000 r per minute at 1 meter through 1/8 inch of lead. The field magnet weighs 275 tons and there are 6 flux magnets of 11 tons each. It operates at 6 pulses per second with about 1 amp. peak current.

This letter gives a long list of other interesting data about the machine. The writers report observing meson tracks in photographic emulsions (from photodisintegrations). R. R. NEWELL, M.D.
Stanford University

**Element 98 (Californium (Cf)).** (Letter to the Editor.) S. C. Thompson, K. Street, A. Ghiorso, and G. T. Seaborg. Phys. Rev. **78:** 298, May 1, 1950.

A new element, made by irradiating $Curium^{242}$ with 35 Mev helium ions, has been named Californium. It is believed to have a number 244 and a half life of forty-five minutes, emitting alpha particles of 7.1 Mev energy. R. R. NEWELL, M.D.
Stanford University

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